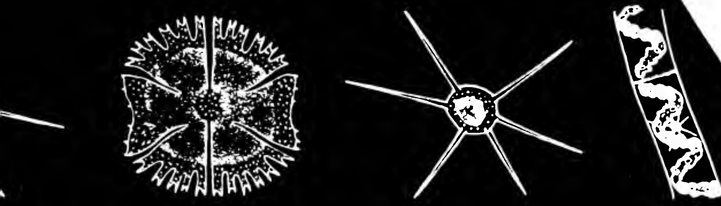

HOW TO KNOW

THE FRESH-WATER ALGAE

G. W. PRESCOTT

Pictured Key Nature Series

How To Know

THE FRESH-WATER ALGAE

An illustrated key for identifying the more common Fresh-water Algae to genus, with hundreds of species named and pictured and with numerous aids for their study.

by

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Pictured-Key Nature Series

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INTRODUCTION

HARDLY any body of water or moist spot on the face of the earth is devoid of algae. They are almost as nearly ubiquitous as are the bacteria which are perhaps the most widely distributed organisms in the world. The variety of form and color exhibited by the algae is seemingly endless and Nature has shown no bounds in designing these ornate plants, many of which have bizarre shapes and specialized habits.

Because of the bright colors possessed by many algae and because their extensive growths which develop in ponds and streams, algae frequently attract attention. The more conspicuous growths of freshwater algae are usually referred to erroneously by the stranger as "water moss," "moss," "frog-spittle," or are sometimes called "pond scums." This illustrated key is designed to give the student who is equipped with a microscope an opportunity to explore the world of freshwater algae and to give the correct scientific name (at least the genus name) to the more common forms. The student may find to his surprise that a clot of "moss" will include half a dozen or more distinct and recognizable plants, each with its own individual characteristics of form, method of reproduction, and life history. In some collections taken from acid bogs as many as 200 or more different species may be found.

It is hoped that this book will be a help in identifying the genera of freshwater algae and that it will serve toward the elimination of the indefinite and erroneous names under which they pass. To be sure, the naming of a plant or an animal is not necessarily an end unto itself—but identification and naming must serve as a basis for a study of structure, life history, ecological distribution and economic importance. Just as when one knows the name of a person and so can then learn more about him (or her), so the naming of algae can be the beginning of further investigation for the pure pleasure of getting acquainted with the world of aquatic life about us, or for scientific pursuits.

Having found the generic names of freshwater algae, the student may wish to identify the plants according to their specific names. For this he will want to turn to some of the works listed in the bibliography. An attempt has been made in illustrating the genera of algae to present the most common species that one is likely to meet, or to give illustrations of several species of a genus. In many cases, among the one-celled and colonial genera especially, there is considerable variation in form among the species contained in a genus. The student will

need to keep this point in mind when matching a plant under consideration with the illustrations in the key. A plant in question may be a species somewhat or quite unlike the one shown.

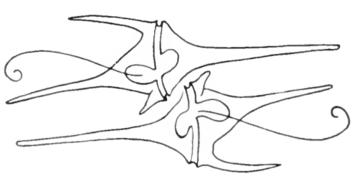
The generic names used in the key are those of long-standing and the ones to be found in floras and handbooks the world over. In a few instances the names have been reduced to synonymy by specialists who have critically examined the old taxonomic literature for long-forgotten synonymies. The advanced student is urged to look into the writings of specialists if he wishes to adopt the recent taxonomic terminologies.

East Lansing, Michigan
August 1, 1954

G. W. Prescott

We first met Doctor Prescott when he was working on the Algae of Iowa as a graduate student at our State University. We've had some pleasant correspondence through the years since then and now it is a pleasure to include the results of his years of study in our Pictured-Key Nature Series.

H. E. JAQUES
Editor



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CHINESE IDIOGRAPH FOR THE WORD ALGAE.

WHAT ARE ALGAE

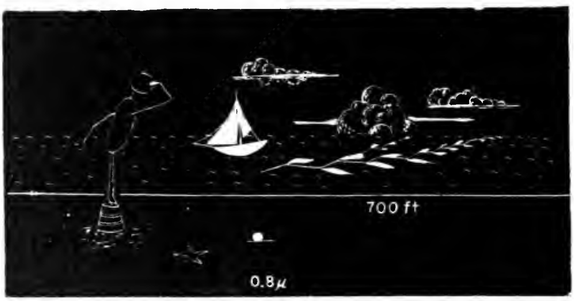
ALTHOUGH most freshwater algae are microscopic, many kinds are gregarious and occur in such numbers as to form the well-known and conspicuous "pond scums," "water blooms," or "water mosses." A few genera are individually large enough to be seen easily without the aid of a microscope, e.g., the stone-worts (Characeae), or some of the freshwater red algae such as *Batrachospermum*.

If it were possible for freshwater algae to grow as large as some other plants (mosses and ferns for example) and to live upon land, they would be considered highly attractive indeed and would be much cultivated as ornamentals. The symmetry of form and the patterns of external decorations which many of them possess are not excelled by the larger plants in beauty. The varied shapes of both marine and freshwater algae, coupled with their many colors and hues have made them the subject of observation and wonderment for a long time, especially since the invention of the microscope. Indeed, the microscopic size of most of the freshwater algae make them all the more intriguing, and since the early days of the first microscopical club they have been used for pleasurable observation and speculation. It is not the aesthetic quality alone of freshwater algae, of course, which explains the amount of interest shown them. For small though they are, freshwater algae (like some of their microscopic kin in the oceans) have their own economic importance. Their relationship to aquatic biology problems of various kinds, their troublesome contamination of water supplies, and their use in general physiological research constitute just a few of the manv aspects which lead to a study of them. Purely scientific problems such as their role in organic evolution, the biology of their reproduction and life histories, and their ecology are common subjects of investigation. Although much is still to be learned from them, the solution, or at least clarification, of many problems in general biology and physiology have been obtained from studies of algae. At this time, for example, much attention is being given to algae in culture for the study of highly important and practical problems in photosynthesis and the products of algal metabolism. Some genera of unicellular algae are

being used for the assay and detection of biologicals (vitamins and growth-promoting or growth-inhibiting substances) in tissue culture work. Some of the research on cancer involves studies in the physiology and reproduction of algal cells.

Whatever the interests in freshwater algae may be, the student who has access to a microscope can find many hours of fascination in a few drops of pond water.

The term "algae," derived from the Latin name for sea-wrack, has come to be applied to all relatively simple marine and fresh-water vegetation. Actually, of course, many different kinds of organisms are included among the plants which lie outside or below the realm of mosses (Bryophytes), the ferns (Pteridophytes), and the seed-



bearing plants (Spermatophytes). Included under "algae" are the smallest and most simple of chlorophyll-bearing organisms, the entire plant being but a single cell. Some of these may be less than 1 micron in diameter. At the other extreme, some of the brown algae (Phaeophyta) include the longest plants in the world. One of the kelps *(Macrocystis)* of the Pacific Ocean, for example, may reach 700 feet, and even greater lengths have been claimed.

The student soon learns that "algae" include several divisions or phyla of the plant kingdom, and that there are incorporated even some groups of organisms, which, strictly speaking, belong neither to the plant nor to the animal kingdom (Euglenaceae, Dinoflagellatae, and many of the yellow-green algae such as *Synura* and *Dinobryon).* These are forms which usually are treated as chlorophyll-bearing protozoa in a reference book dealing with one-celled animals. Several of the swimming, protozoan-like forms have definitely plant-like, non-motile relatives, however, which more than justify their being given a place among the algae.

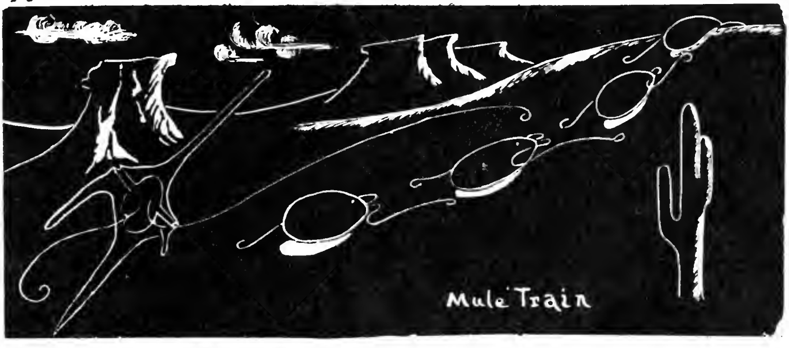
The reader who is not familiar with the classification of plants and animals, and with the terminology used for the different categories may wish to refer to the following definitions.

SPECIES. A particular kind of plant or animal is called a species. For example, a certain rose, or a particular alga such as a "pond silk," or a particular bird is known as a species and is given an identifying or specific name. Because there is so much (although slight) variation between individuals which are in general very much alike, the limitations or precise definition of a species of plant or animal is often difficult to draw and is subject to different interpretations of specialists.

GENUS. All plants which obviously are roses, but not all the same kind, are grouped together and constitute what is known as a genus (plural, genera). Thus all different species of roses are placed in the genus *Rosa*, the Latin name for the genus. All species of "pond-silk" are placed in the genus *Spirogyra*. The genus name, *Spirogyra*, and a species name (a particular kind) together constitute the *scientific name*. For example, *Spirogyra elongata* is the scientific name of a species which has long cells; *Rosa cinnamonea* is the cinnamon rose. This method of naming each kind of plant and animal with a double name is known as the *binomial system* of nomenclature. The double name identifies not only a particular kind of individual but also indicates to what group (genus) it belongs.

FAMILY. The genus *Rosa* has much in common with the strawberry genus *(Fragaria)*, and is much like the prune genus *(Prunus)*. Similarly *Spirogyra* has much in common with another group of species which constitute the genus *Mougeotia*. Therefore, *Rosa*, *Fragaria*, *Prunus*, and other genera that have characteristics much in common are grouped to form what is called a *family*. In this case, the Rosaceae or Rose family. *Spirogyra*, *Mougeotia*, *Zygnema* and some other algal genera which have characteristics in common and which seem, therefore, to be related are grouped to form the family Zygnemataceae.

ORDER. In turn, families which are distinct from one another but which, nevertheless, have some few characters in common are grouped to form what is known as an *order*. Thus we have the Rosales, the Zygnematales, etc.



MOST ALGAE ARE AQUATIC

DIVISION or PHYLUM Several orders may be grouped to form a major category known as a Division or Phylum of the plant kingdom (or of the animal kingdom as the case may be). Thus several orders of the green algae constitute the division (phylum) Chlorophyta. In many instances it may be convenient to subdivide the phylum into groups of orders called *classes*. Hence in the Chlorophyta there are recognized 2 classes, Chlorophyceae and Charophyceae. In the key which follows only the genus names are given, with illustrations of 1 or 2 common species. For this reason particular species in which the student may be interested in identifying will not necessarily look exactly like the ones illustrated. In so far as possible, the most distinctive features of the genus are shown in the illustrations.

THE PHYLA OF ALGAE

THE organisms which constitute what are commonly known as freshwater algae are extremely diverse in form, color, habit, and in their habitats. Actually, there are as many as eight separate phyla or divisions of the plant kingdom included under the name "algae," (nine if Cryptophyceae of uncertain position are given the status of a division). Hence to undertake writing descriptively about freshwater algae, one is confronted with almost as great a task as if he were treating all the phyla of land plants, fungi, mosses, ferns and the seed plants, plus three additional groups all in one work. To be sure all the phyla of 'algae' do not include as many families and genera as do some of the higher plants, but the green algae alone include some ten or twelve thousand species, distributed among about 375 genera. The task of the writer in describing freshwater algae is not made easier by their relatively small (mostly microscopic) size. Hence it is necessary to employ special descriptive terms in order to differentiate these minute organisms, and to classify properly the classes and phyla to which they belong.

In such a treatment as is presented here, only the most common and best known genera can be given a place. The reader should have this in mind when using the key. He should avail himself of other less abridged or monographic works if satisfactory identification of a plant in which he is interested does not appear possible by the use of the following key.

The illustrated key is intended to assist the beginning student and the non-specialist (equipped with a microscope) in identifying the genera of freshwater algae which occur in the United States. Such a key cannot be made as easy to use as are many keys to larger organisms. But an attempt has been made to overcome some of the usual difficulties by keying out some genera at several different points, especially those which are so variable that selection of any one set of differentiating criteria for them is almost impossible. At least, a beginning student or one with little familiarity with the algae, must exercise patience until he has developed some degree of judgment and has become well-acquainted with the meaning of terms, and until he has discovered to what degree a plant may vary from the usual character employed in making an identification. Many times he will find it profitable, if not necessary, to "back-track" in using the key and follow down both dichotomies of choice before arriving at a satisfactory determniation. In making use of the illustrations it must be remembered that only one or two species of a genus are illustrated, and that the plant in which one may be inter-

ested does not have to look exactly like the forms which are figured. This is true for many of the genera in the Chlorococcales of the Chlorophyta (*Scenedesmus, Oocystis, Tetraedron,* etc.) and of the desmids (*Cosmarium, Euastrum, Micrasterias,* e. g.) also in the Chlorophyta.

For a study of most freshwater algae a compound microscope is needed which has a 10X ocular, and a 10X and 40X objective. For the study of the larger forms such as the stoneworts (Characeae) a binocular dissecting microscope is highly desirable. Best illumination for the microscope is obtained from daylight because colors of the algal pigments appear more naturally. In lieu of good daylight (light from a northern window preferred), artificial light from a microscope lamp fitted with a daylight blue bulb is used, or a lamp which has a blue filter. Naturally, all optical parts of the microscope should be kept free of dust, moisture, and finger prints, using rice lens paper for cleaning. It is difficult enough to see algae clearly when optical conditions are perfect. An eye-piece micrometer is desirable.

In preparing mounts for the study of algae under the microscope, small amounts of material should be used, and spread out evenly in a thin layer. Dense clumps and opaque masses of algae in a microscope mount produce only disappointment and headaches.

One of the primary difficulties with which the inexperienced student is confronted when first using a general key to the algae is that of detecting and identifying colors, green, "blue-green," "yellow-green," etc., to which the key makes reference. Pigmentation in the different algal groups is a fundamental characteristic and one which is very helpful in making identification. But yellow-green algae may at times appear decidedly grass-green, and the brown-pigmented algae may have a distinct tinge of green, especially when artificial light is used for the microscope. Hence, other characters or a combination of characteristics excluding or in addition to color must be employed to make a choice in the key. Suggestions are given in appropriate places in the following key for making certain tests to help differentiate genera on the basis of color. Although it is a combination of characters which differentiates algae in the final analysis, the key can select these characters one by one only.

The three major phyla of algae (those which are the most common) are the green algae, the blue-green, and the yellow-green (yellow-brown). It is suggested that in order to facilitate the differentiation of a green, a blue-green, and a yellow-green alga, that (if possible) a known green alga *(Spirogyra)*, a blue-green *(Anabaena)*, and a diatom (yellow-brown) be mounted on a microscope slide so that their color and the details of cell structure might be compared. Then a series of illustrations depicting these groups of the algae should be examined so that the gross morphology and the details of cell structure will become associated with the respective pigmentations.

The phyla of freshwater algae herein recognized are as follows:

1 Chlorophyta (Green Algae).

Plants unicellular, colonial, or filamentous; swimming, floating, or attached and stationary; cells containing plastids in which chlorophyll (grass-green) is predominant, and in which there is usually a shiny, starch-storing body, the pyrenoid; pigments are chlorophyll, xanthophyll, carotene; starch test with iodine positive (in almost every instance); nucleus definite (although often small and inconspicuous); cell wall usually relatively thick and definite, composed of cellulose and pectose; swimming cells or motile reproductive elements furnished with 2-4 flagella of equal length attached at the anterior end; sexual reproduction by iso-, aniso- and by heterogametes.

2 Cyanophyta (Blue-Green Algae).

Plants unicellular, colonial, or in simple or branched (sometimes falsely branched) filaments; without chloroplasts but with pigments in solution and coloring the entire protoplast; variously colored with a combination of chlorophyll, xanthophyll, carotene, phycocyanin, and phycoerythrin; cell wall thin, a membrane which usually has a gelatinous outer sheath; contents often with false (pseudo-) vacuoles which refract light and obscure the true color of the cells; definite nucleus lacking but occurring as a cluster of granules in the mid-region (central body) of the cell; motile cells and sexual reproduction wanting; asexual reproduction by cell division (fission) or rarely by spores (akinetes); food storage questionably glycogen, possibly floridean starch; iodine test for starch negative.

3 Chrysophyta (Yellow-Green, or Yellow-Brown Algae).

Plants unicellular or colonial, rarely filamentous; pigments contained in chromatophores in which yellow or brown often predominates, chlorophyll, carotene and xanthophyll also present (some chromatophores appearing pale green or yellow-green); food storage in the form of oil or leucosin, the latter often giving the cell a metallic lustre; starch test with iodine negative; wall relatively thick and definite, pectic in composition, often impregnated with silicon (especially in the diatoms), and sometimes built in 2 sections which overlap in the mid-region; motile cells and swimming reproductive cells furnished with 2 flagella of unequal length, or with but a single flagellum; rhizopodial (pseudopodial or amoeboid) extensions of the cell not uncommon in some families.

4 Euglenophyta. (Euglenoids).

Cells solitary, swimming by one (usually) or by 2 (rarely 3) flagella; a gullet present in the anterior end of the cell in many members, as is also a red pigment (eye) spot; chloroplasts few to many variously shaped green bodies (a few relatives colorless); a chlorophyll-like pigment predominating, but with carotene also present; nucleus large

and centrally located; food reserve in the form of an insoluble starch-like substance, paramylum which is negative to the starch test with iodine, and fatty substances; cell membrane in the form of a pellicle, rigid or plastic, frequently striated; sexual reproduction unknown.

5 Cryptophyta (Cryptophyceae of some authors).

Cells solitary or colonial; mostly swimming by means of 2, often laterally placed or sub-apical flagella; chromatophores large and brown, or rarely blue, often with pyrenoids; food reserve in the form of starch or oil; membrane firm but relatively thin; sexual reproduction unkown.

6 Pyrrhophyta. (Dinoflagellates).

Cells solitary or (rarely) filamentous; mostly swimming by means of 2 flagella, one commonly wound about the cell in a transverse furrow, and one extended posteriorly from the point of flagellar attachment in a longitudinal furrow; cells dorsiventrally flattened and differentiated, the longitudinal furrow extending along the ventral surface; cell wall, if present, firm and often composed of regularly arranged polygonal plates (as in the so-called armored or thecate Dinoflagellates); pigments chlorophyll, carotene, four xanthophylls, brown phycopyrrin, red peridinin (the latter sometimes predominating) contained within chromatophores; food reserve starch or a starch-like substance, and oil; a pigment (eye) spot often present; sexual reproduction unknown.

7 Rhodophyta. (Red Algae).

Plants simple or branched filaments (unicellular in one questionable form); pigments contained within chromatophores, are chlorophyll, xanthophyll, carotene, phycocyanin and phycoerythrin, in the freshwater forms appearing blue-green, gray-green, or violet (not red); food reserve in the form of a special starch (floridean) which is negative to the iodine test for starch; walls relatively thick and often mucilaginous, sometimes furnished with pores through which protoplasmic extensions occur; sexual reproduction by heterogametes, but the male elements drifting and not swimming; thalli often of macroscopic size.

8 Chloromonadophyta (Chloromonads).

An obscure and little-understood group composed of but a few genera and species; cells swimming, flagella one or two, apically attached; chromatophores green, with chlorophyll (supposedly) predominating, but with an abundance of xanthophyll also present; food reserve in the form of oils or a fat; contractile vacuoles and a reservoir in the anterior end of the cell; cell contents with trichocysts radiately arranged just within the cell membrane (in the genus *Gonyostomum*), sexual reproduction unknown.

9 Phaeophyta. (Brown Algae).

A phylum mostly marine, including the brown sea weeds (kelps); essentially filamentous (some microscopic) but mostly robust and leathery; pigments include chlorophylls, carotene, xanthophyll, and fucoxanthin (predominating brown pigment); food reserve soluble carbohydrates including alcohol (mannitol); reproduction asexual by kidney-shaped zoospores with 2 lateral flagella or sexual by iso- aniso- or heterogametes.

SYNOPSIS OF THE ALGAL PHYLA

SINCE many species and whole divisions of algae are principally marine in habitat, the following general key or synopsis is given as an aid to a better understanding of the algal groups in fresh-water.

1 Cells without chloroplasts or chromatophores; pigments blue-green, olive-green, or purplish, distributed throughout the entire protoplast (although cells may be somewhat less colored in the central region); wall usually thin (often showing as a membrane only) and generally with a mucilaginous sheath (wide or narrow, watery or firm and definite); food reserve in the form of glycogen or a starch-like substance; iodine test for starch negative; no motile cells present. ....Blue-Green Algae................CYANOPHYTA

1 Cells with chloroplasts or with chromatophores, the pigments not distributed throughout the protoplast; cell wall clearly evident (with rare exceptions *Pyramimonas*, see Fig. 30, e.g.); stored food not in the form of glycogen; iodine test for starch positive or negative...2

2 Cells with grass-green chloroplasts (but see some species of *Euglena*, see Fig. 8, or the filamentous alga, *Trentepohlia*, see Fig. 171 which, although possessing chlorophyll, have the green color masked by an abundance of the red pigment, haematochrome).............3

2 Cells with cholorplasts or chromatophores some other color, gray-green, brown, violet-green, or yellow-green, sometimes purplish...5

3 Free-swimming, unicellular; with numerous ovoid, star-shaped, or plate-like chloroplasts which are grass-green; food stored as clearly evident grains of insoluble paramylum (sticks, or plates); iodine test for starch negative; one or two (rarely three) coarse flagella attached at the apex in a gullet; eye-spot or red pigment spot usually evident...............Euglenoids...........EUGLENOPHYTA

3 Organisms not as above....................................4

4 Unicellular, without an eye-spot; chloroplasts numerous discs usually radially directed at the periphery of the cell; motile by means of 2 flagella inserted in an apical reservoir; trichocyst organelles usually present just within the cell wall; food reserve oil.................. ...................................CHLOROMONADOPHYTA

4 Unicellular, colonial, or filamentous; swimming or not swimming (although often free-floating); when swimming using 2 to 4 fine flagella attached at the apex of the cell but not in a colorless reser-

voir; chloroplasts 1 to several, usually with a conspicuous pyrenoid (starch-storing granule); iodine test for starch positive........... Green Algae ....CHLOROPHYTA

5 Chromatophores light olive-brown to dark brown; nearly all marine, essentially filamentous, but occurring mostly as thalli of macroscopic size (brown sea weeds); stored food in the form of laminarin and alcohol; starch test with iodine negative.................. Brown Algae ....PHAEOPHYTA

5 Plants marine or fresh-water, but not occurring as brown thalli of macroscopic size 6

6 Chromatophores yellow-green to yellow- or golden-brown; food in the form of leucosin or oil; starch test with iodine negative; plants unicellular, colonial or filamentous; sometimes swimming with apically attached flagella; many forms (especially the diatoms, see Figs. 328-337) with the cell wall impregnated with silicon...... Yellow-green Algae ....CHRYSOPHYTA

6 Chromatophores not yellow-green or pale green, but dark golden brown, gray-green, violet-green; food in the form of oil or starch-like carbohydrates; iodine test for starch mostly negative.........7

7 Unicellular, with dark, golden-brown chromatophores; swimming by means of 2 laterally attached flagella; a conspicuous eye-spot usually present; many forms with the cell wall composed of polygonal plates ....Dinoflagellates.............PYRRHOPHYTA

7 Organisms unicellular or filamentous, not swimming by means of laterally attached flagella; chromatophores brown, green, bluish, violet-green or gray-green...................................8

8 Chromatophores violet or gray-green, sometimes bluish-green in fresh water, red in marine forms; occurring as filamentous thalli of both macroscopic and microscopic size; food stored in the form of starch-like carbohydrates; starch test with iodine negative....... Red Algae ....RHODOPHYTA

8 Chromatophores one or two golden-brown (rarely blue) bodies; organisms unicellular; swimming by means of sub-apically attached flagella; food reserve in the form of starch-like carbohydrates; iodine test positive in some............................CRYPTOPHYTA

(This class of the algae has several characteristics in common with Dinoflagellates and in some systems of classification is included under the Pyrrhophyta.)

HOW AND WHERE TO COLLECT FRESH-WATER ALGAE

FILAMENTOUS algae can be collected from mass growths by hand, of course, and representative tufts placed in vials or collecting jars. Less conspicuous forms may be found as fuzzy films on submerged grasses, old rush culms, and sticks. Using the fingers these growths can be lifted away or pulled from their attachment, or short sections of stems of aquatic plants and grass leaves can be placed in vials and the algae removed with scraping tools in the laboratory. A dropping pipette and a pair of tweezers are useful for collecting minute forms.

Using the back of the thumb nail, or a dull-edged knife will serve, greenish coatings on rocks and submerged wood can be scraped away. Such an instrument is useful for removing samples of green or brown felt-like or mucilaginous growths from wet stones about waterfalls, from dripping cliffs and rocky outcrops.

Submerged glass, shells, and bits of crockery in the water furnish substrates for many algae which occur as inconspicuous green discs or tufts. Old, rotting wood may be perforated with algae which lie so far below the surface that they are scarcely visible, but wood that appears at all greenish from the exterior should be examined.

Feel under the rim of dams or along the edges of stones in flowing water. Many blue-green and also some of the more rare freshwater red algae occur in such habitats.

On and in damp soil are to be found numerous species of Cyanophyta and diatoms. Sometimes algae occur in pure strands' and sheets or films of a single species may be lifted or scraped from soil, wet boards, and the face of moist cliffs.

On beaches near the water line, but back far enough where the sand lies unmolested most of the time, the upper dry layer of sand may be removed to disclose a densely green stratum of algae. The green sand can be scraped into a container and rinsed, and then when the water is poured off in the laboratory an interesting mixture of algae will be found, together with a variety of microscopic animals (protozoa, rotifers, copepods, etc.). This biotic cosmos is known as *psammon* and includes many organisms that normally occur in sandy beaches although not in the open water of a nearby lake or stream.

In *Nitella* (one of the large green algae), in *Lemna trisulca* (one of the duckweeds), in *Ricciocarpus natans* (a floating liverwort) occur various green and blue-green endophytic algae. Small portions of these

aquatic plants, and others as well, may be allowed to age and to become discolored in dishes of water in the laboratory. The endophytes (and some epiphytes too) will then appear more clearly and can be dissected away for study.

In humid climates trunks of trees and surfaces of leaves may have epiphytic or endophytic (semi-parasitic) algae such as *Trentepohlia*

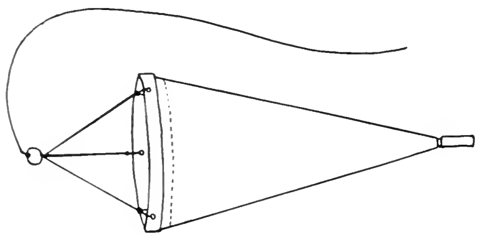
The habitats of freshwater algae are very diverse, some living in hot springs where the water is nearly at boiling temperature; others in snow banks in high mountains; whereas one alga normally occurs on the back of the snapping turtle.

and *Cephaleuros*. *Arisaema* (Indian turnip) leaves invariably contain the parasitic alga, *Phyllosiphon*, which causes yellow or red spots in the host tissues.

One interesting habitat is the back of snapping turtles where the coarse, wiry filamentous alga, *Basicladia* is invariably found. Other algae may be associated with *Basicladia* on the 'mossy' backs of turtles, whereas alligators are sometimes veritable algal gardens and offer a variety of interesting forms for the less timid collector. In the rain-forests of the tropics, Central America, e. g., the three-toed sloth harbors among its hair scales a minute red alga, *Cyanoderma bradypodis*, and a filamentous green alga, *Trichophilus welcheri*.

In alpine and subalpine regions where there are banks of permanent snow, red streaks will be found at the margins of the snow fields. The streaks are produced by the unicellular green alga, *Chlamydomonas nivalis* which contains a red pigment (haematochrome) which is developed in the cells when they are exposed to intense

light. A small quantity of red or 'bloody' snow when allowed to melt in a jar may yield a surprising quantity of this and other genera such as *Scotiella*, *Ankistrodesmus*, and certain Dinoflagellates.



THE PLANKTON NET

Specimens collected from the open water (planktonic algae) are best collected with a cone-shaped, silk, bolting cloth net (No. 20). Plankton nets are obtainable from biological supply houses, or may be made up by securing a yard of the silk from an importer or from a flour mill. (The Limnological and Oceanographic Society of America publishes a list of commercial houses and firms where various kinds of collecting equipment may be obtained.) A light-weight, brass (preferred) or thin galvanized iron ring (stout wire), or band may be used for the mouth of the net. A convenient size is a ring about 6 or 8 inches in diameter. Using a pattern, (see Welch, P. S. 1948. Limnological Methods, Blakiston Co., p. 234-235) cut the silk so that when attached to the ring a cone about 14 inches long is formed. The silk should not be attached directly to the ring, but sewed first to a band of stout muslin which then may be sewed over the ring or metal band. If a flat band is used for the mouth of the net the edges should be filed smooth and rounded to eliminate as much cutting and fraying of the muslin cloth as possible. The net may be used as a closed cone, in which case after a sample has been collected, the net must be turned inside out and the material washed off in a dish or jar. More conveniently, the tip of the cone may be cut off at a point (about ½ in. or less from the end) which will permit the insertion of a small homeopathic vial (4 to 6 dram capacity) which can be tied about its neck into the apex of the net. Thus the sample will become concentrated in the vial and when the net is reversed the material can be poured out into a collecting bottle, and the net rinsed before another sample is taken. Better still, a small metal (lightweight) band, threaded to receive a screw-cap vial neck can be sewed into the tip of the net. Then the vial can be simply unscrewed and a fresh one inserted after the net has been rinsed.

The net should have 3 leaders of equal length attached to the ring at regularly spaced points. The leaders should be tied to a small ring to which the tow cord is also attached. Use a heavy line

such as a stout chalk line for the pull cord and the leaders. Braided copper wire is sometimes used for the leaders but these often become so worn at the points of attachment that they snap.

Microscopic forms of algae may be obtained in great numbers from the squeezing of *Sphagnum* (and other mosses) especially when the plants feel slippery or slimy. Small pools and seeps in *Sphagnum* beds abound in many species of algae, especially desmids. The moss or overhanging dead grass and stems of rushes can be squeezed di-

Utricularia, an under-water animal-trapping plant, is a veritable Christmas tree loaded with miscellaneous algae which are caught among the leaves and held in the mucilage that envelopes the plant.

rectly into a vial, or if a gross, mass collection is desired, the moss can be squeezed into the plankton net so that a concentrated *puree* of algae is obtained. *Utricularia* (bladderwort), especially when it occurs in soft water or acid lakes, is a veritable net itself and handfuls of this plant can be squeezed into a plankton net with very fruitful results.

Specimens collected from the field should be put in receptacles with just enough water to cover them, leaving ample space for air, especially if the sample is to be stoppered for some time before arriving at the laboratory. Clots of larger, filamentous algae may have the excess water gently squeezed from them, rolled in wet, and then in dry paper (newspaper highly satisfactory) and so may be kept in good condition for 24 hours or more.

Immediately upon returning from the field, vials or packets of material should be opened and poured into wide, shallow dishes so that they may be well aerated. If the collection is not too crowded in a dish of water the plants may be kept alive and in good condi-

tion almost indefinitely, especially if the dishes are stored in a cool place with reduced illumination such as in a north facing window. Some kinds of algae will remain in satisfactory condition for study (even though additional growth may not occur) when stored in a refrigerator kept at ordinary temperatures used in food storage.

Some collectors prefer to spread algae on cards or stiff paper to dry, and then made into herbarium specimens. In working with such specimens later, a few drops of water placed on the dried plants will soak up the material well enough that it can be lifted away for mounting on a slide. Specimens so treated, however, are not satisfactory for study unless one has had a long experience in examining algae and is familiar with their appearance in the undried condition.

If it is desirable to keep a record of the location from which separate field collections are made, it is obviously necessary to give samples a code number or label at the time they are taken. One satisfactory way of doing this is to carry 3 x 5 inch cards, all but cut through into narrow strips that will fit into the collecting vial. A number can then be written on a slip which is torn off from the card and inserted. Information bearing the same code number can be written into a field notebook for future reference. In the laboratory a permanent number can be assigned to the vial and written on the cork if the material is to be saved for subsequent study.

PRESERVING

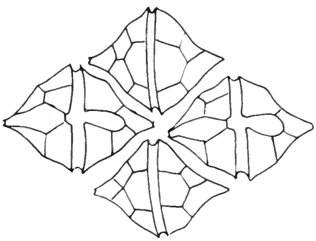
If samples are to be preserved an amount of 6-3-1 preservative equal to the volume of the specimen (and its water medium) may be added to the vial. This preservative is composed of six parts water, 3 parts 95% alcohol, and one part commercial formalin. If 5 cc of glycerin are added to each 100 cc of the preservative, a medium is produced which protects the specimen against total loss should the preservative evaporate. Cork-stoppered vials, as a rule, are much more serviceable than screw-cap vials which permit a greater amount of evaporation of the liquid because the tops loosen upon standing for a time.

Formalin-acetic acid-alcohol (FAA) makes an excellent preservative and is especially suitable if material is later to be prepared for staining. To 50 cc of 95% alcohol add 5 cc of glacial acetic acid, 10 cc of commercial formalin, and 35 cc of water. Proprionic acid may be substituted for the glacial acetic.

For general and incidental preserving, ordinary 3% formalin may be used if the above ingredients are not available. (3 cc of commercial formalin in 37 cc of water.)

If semipermanent microscopic mounts are desired, specimens may be placed on a slide, evenly spread out, in a large drop of 5% glycerin.

The slide should be set away under a dust-proof cover. Once or twice a day for two or three days other drops of the glycerin solution are added until, through evaporation of the water, approximately 100% glycerin is obtained about the specimen. To this a small drop of melted glycerin jelly is added and the cover slip put in place. Care should be used to add just enough jelly to fill out the area under the cover slip so as not to allow leakage from beneath it. The cover may then be ringed with a sealing material such as balsam, colorless fingernail polish, Bismark Black, or Gold Size. (See catalogues of biological supply houses which list other kinds of mounting and sealing materials.)



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PICTURED-KEYS TO THE COMMON GENERA OF FRESH-WATER ALGAE

1a Plants large (macroscopic), up to 40 or more cm. high, growing erect, with stem-like whorled branches and forked "leaves" clearly visible to the unaided eye. Fig. 1-3 ...... Family *Characeae* 2

1b Plants microscopic, or if macroscopic with cellular structures and branches not visible to the unaided eye, or scarcely so 4

2a Branching unsymmetrical, with dense heads of short branches and scraggly longer ones; microscopically showing globular antheridia (male organs) lateral, beside the oval oogonia (female organs). Fig. 1* .... *TOLYPELLA*

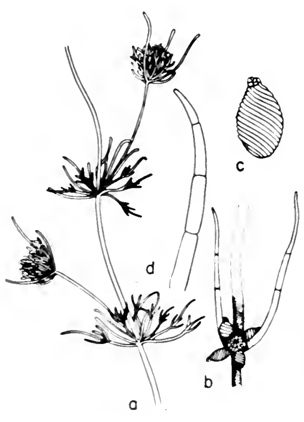

Figure 1

Fig. 1. *Tolypella intricata* (Trentep.) v. Leonh. a, Portion of plant showing habit of branching; b, a node showing four oogonia and one antheridium; c, an oogonium showing the 'crown' cells; d, tip of branch.

A rather rare plant in North America, occurring in hard water lakes mostly. It appears very much like *Chara* (Fig. 2) in need of a hair-cut but unlike *Chara* it does not form dense beds in the bottom of ponds and streams, but occurs singly or in sparse clusters. Under the hand lens *Tolypella* shows its true relationship to *Nitella* (Fig. 3) in not having column-like or fluting cells along the stem and branches.

2b Branching symmetrical with rather evenly spaced whorls of equal-length branches at nodes of the stem; antheridia above or below the oogonia 3

*Some of the illustrations used in this volume have been redrawn from figures previously published by the author.

3a Plants coarse and usually rough with lime; ill-smelling (garlic or skunk odor); microscopically showing spherical antheridia lateral and below the oval oogonia; branches with long, corticating columnar cells about the main axial cell. Fig. 2..............*CHARA* (*Chara coronata* Ziz., however, has no corticating cells.)

Fig. 2a. *Chara canescens* Lois.-Des. A portion of a plant in which thorn-like cells arising from the corticating elements give a spiny appearance; b, one node of *Chara excelsa* Allen showing the oval oogonium above, and the globular antheridium below.

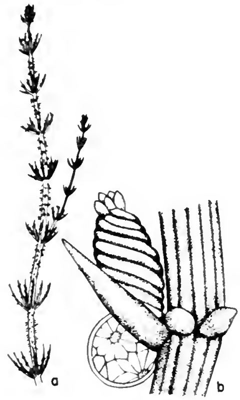

Figure 2

Most of the species, of which there are many, occurring in North America are world-wide in their distribution. They are to be found usually in streams which are slow-flowing or in lakes in which there is considerable calcium. Some species especially are active in depositing lime upon themselves and are so harsh to the touch as to earn the common name "stone-wort." Marl and other kinds of calcareous deposits may be formed largely by *Chara* over long periods of time.

3b Plant delicate, or if relatively stout, not roughened with lime; dark green, not ill-smelling; microscopically with globular antheridia terminal on a short pedicel within a cluster of branches and above the oogania; main axis not corticated. Fig. 3...........*NITELLA*

Fig. 3a. *Nitella tenuissima* (Desv.) Kuetz., habit; b. *Nitella flexilis* (L.) C. A. Agardh, portion of plant showing habit of branching.

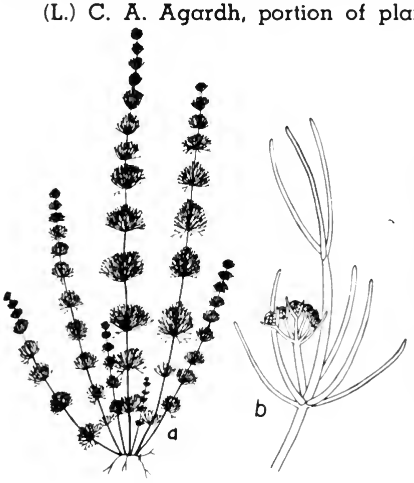

Figure 3

Species of *Nitella* are not seen so often as are the Charas because they usually grow more deeply, thriving in soft water or acid lakes rather than in hard water situations. Some species occur in bog lakes that are darkly stained with humic acids and are collected only by dredging with a plant hook. The plants are greener than *Chara* and are not encrusted with lime; are not ill-smelling.

4a (1) Cells containing chloroplasts (bodies with green pigment predominating), or chromatophores (bodies with colors other than green predominating) 5

4b Cells without chloroplasts and chromatophores, with pigments in solution and more or less evenly diffused throughout the entire protoplast. . . . . Subdivision Myxophyceae 376

5a Plant grass- or leaf-green to gray-green; photosynthetic product starch (iodine test positive), or paramylum (iodine test negative), or floridean starch in the freshwater red algae which are greenish or violet-green (iodine test negative). 6

Note: Because some Chlorophyta, or essentially green algae are often tinged with red or yellow (the green color sometimes masked by the other color), and because normally violet-green Rhodophyta often appear green to the observer, the reader should compare plants being keyed with:

No. 22a in the key, *Haematococcus*, a red unicellular, motile organism;

No. 60a in the key, *Botryococcus*, colonial green alga in a brown, nearly opaque mucilage;

No. 119a in the key, *Rhodochytrium*, a red unicell in the tissues of higher plants.

No. 238a in the key, *Trentepohlia*, an orange-colored member of the Chlorophyta.

No. 239a in the key, *Batrachospermum*, a filamentous member of the Rhodophyta which is gray- or violet-green;

No. 256a in the key, *Cephaleuros*, a filamentous, semiparasitic and nearly colorless member of the Chlorophyta;

No. 265a in the key; *Leptosira*, a yellowish-green filamentous member of the Chlorophyta; and

No. 304a in the key, *Botrydium*, a green, balloon-like vesicle, belonging to the Chrysophyta.

Also, see *Trachelomonas*, Fig. 5, identified by a brown shell which incloses a green protoplast, and *Dinobryon*, Fig. 243, which has a colorless, cone-shaped envelope (lorica) containing a protoplast which appears greenish.

5b Plant not grass- or leaf-green (but see *Botrydium*, Fig. 214, which is green but belongs to the Chrysophyta (yellow-green algae); color light green, violet-green, yellowish or brown; iodine test for starch negative 283

6a Plants swimming in the vegetative state, solitary or colonial. (Preserved specimens should be examined for 2 or more minute protuberances at the anterior end of the cell which locate the position of the flagella (organs of locomotion) that may have been retracted or lost). Use 5% glycerine for mounts. See fig. 17. 7

6b Plants not motile in the vegetative state; (check to be sure cell is not a swimming organism at rest; see *Trachelomonas*, Fig. 5 which although motile, is commonly found as a non-motile, brown shell (lorica) from which the swimming protoplast has escaped); solitary, colonial or filamentous. 35

7a Cells broadly ovoid or oval in outline, flattened as seen from the side; chloroplasts radiately disposed at the periphery of the cell; flagella 2, 1 trailing. Fig. 4. Division Chloromonadophyta...... ....*GONYOSTOMUM*

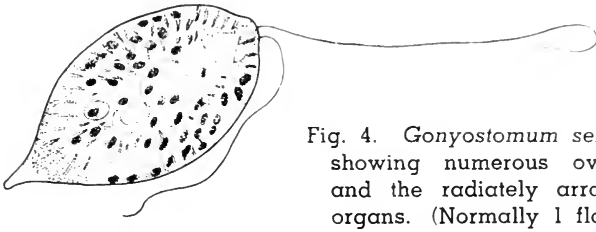

Figure 4

Fig. 4. *Gonyostomum semen* (Ehr.) Stein, showing numerous ovoid chloroplasts and the radiately arranged "stinging" organs. (Normally 1 flagellum is directed forward.)

This rare swimmer occurs mostly in acid bogs and in shallow lakes, accompanying certain species of *Euglena* (See Fig. 8). Under the microscope it reminds one of a flat, green bottle; usually is quiet in the microscope field so that its unique internal structure can be studied easily. It has sudden, jerky movements for short distances.

7b Cells round or oval when seen in both front and side view, sometimes slightly flattened, but with flagella directed forward; chloroplasts not arranged as above; flagella 2, 4, 1*....................8

8a Cells with numerous, disc-like (rarely ribbon-like chloroplasts); food reserve in the form of variously shaped, colorless or white paramylum bodies (See Fig. 6) which do not stain blue-black with iodine; slow-moving by a stout flagellum (See Fig. 8); a red eyespot usually evident........Division EUGLENOPHYTA...........9

8b Cells with 1 cup-shaped or star-shaped chloroplast, usually containing one or several conspicuous pyrenoids (doughnut-like, shiny bodies buried in the chloroplast or on its surface); food reserve starch, iodine test positive; lens-shaped eye-spot usually evident; actively swimming with fine, often obscure flagella. (See Fig.13). (Add 5% glycerin to mount to slow down organisms for observation). 12

*Colorless, one-celled, swimming relatives of *Euglena* are not included here. *Paranema* and *Astasia* are examples of these strictly protozoan-like genera. *Peranema* has one stout, rather rigid flagellum extended anteriorly, and a fine, inconspicuous one appressed close to the cell body. *Astasia* is highly plastic; swims by one flagellum; has a prominent gullet in the anterior end.

9a Cells inclosed in a brown shell (test), variously shaped, (round, oval, or flask-shaped), often with a collar about the aperture through which a single flagellum extends. (The variously shaped cells of this genus frequently are found empty, yellow to dark brown, smooth or decorated.) Fig. 5 . . . . *TRACHELOMONAS*

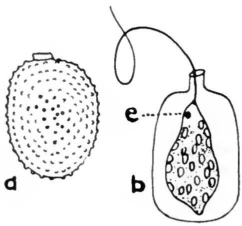

Figure 5

Fig. 5a. *Trachelomonas granulosa* Playf., a short-collared species which has a warty shell; b. *Trachelomonas euchlora* (Ehr.) Lemm., protoplast within shell, showing eye-spot, chloroplasts, and flagellum.

There are several hundred species of *Trachelomonas*, each showing a differently shaped shell, or lorica, and each having its own special style of decoration. Usually the loricas are found empty, brown, yellow, or sometimes nearly colorless (determined by the amount of iron present in the shell), intermingled with the miscellaneous algae that grow in shallow water or bogs, or among weed beds near the shores of lakes.

9b Cells not inclosed in a test 10

10a Cells flattened as seen from the side and often twisted; broadly fusiform or nearly round in outline when seen from the front; paramylum in the form of one to several 'doughnut' rings, or discs. Fig. 6 . . . . *PHACUS*

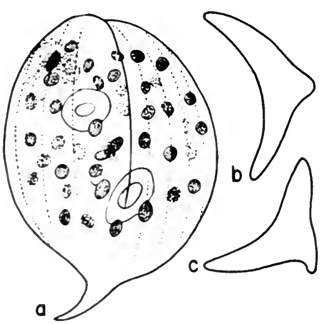

Figure 6

Fig. 6a. *Phacus curvicauda* Swir., front or ventral view showing eye-spot, chloroplasts, and 2 ring-shaped paramylum bodies (food reserve); b, c, *Phacus triqueter* (Ehr.) Duj. as seen in end view, the triangular shape being produced by the dorsal flange.

Although some species are spirally twisted and 'top-shaped' most are flat or at most are only slightly saucer-shaped or pancake-like, with a long or short tail-piece. The rings of storage material are usually very conspicuous and so large as to fill nearly the entire diameter of the cell.

10b Cells not flattened, round in cross section; either elongate-fusiform or oval to round or somewhat pear-shaped in outline; paramylum bodies different from above 11

11a Cells round, oval or pear-shaped, rigid, fixed in shape when swimming; paramylum in the form of 2 large lateral rings; tail-piece, if present, usually in the form of a short, sharp protrusion from the rounded posterior end of the cell. Fig. 7. . . . .*LEPOCINCLIS*

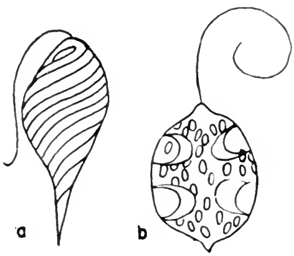

Figure 7

Fig. 7a. *Lepocinclis acuta* Presc., showing spiral markings of the periplast (membrane); b, *Lepocinclis glabra* fa. *minor* Presc., showing four lateral, band-like paramylum bodies.

Round when seen on end, rather than flat like *Phacus* (Fig. 6). The storage material in most species forms 2 rings that lie along the side walls of the cell. Often with *Euglena* (Fig. 8), but much more active.

11b Cells often changing shape when swimming (rigid in some species), elongate, nearly cylindrical, or fusiform; paramylum in the form of a few and large, or numerous, small, colorless rods or sticks; tail-piece formed by gradual narrowing of the cell. Fig. 8. . . . .*EUGLENA*

Figure 8

Fig. 8a. *Euglena convoluta* Korsch., showing lateral paramylum plates as seen on edge, one in flat view; b, *E. elastica* Presc. Both of these are metabolic species (changing shape while in motion) whereas some forms are rigid.

Although usually green, these elongate, slowly moving species sometimes are colored red because of a pigment, haematochrome. A pond or slough may have a bright red film over the surface caused by *Euglena* which seem to produce the pigment in response to intense light.

12a (8) Plant a colony of 4 or more cells, either closely adjoined, or free from one another within a gelatinous envelope. . . . . Division CHLOROPHYTA (in the main). 13

12b Plant a solitary cell. 22

13a Cells arranged in a plane, forming a plate (flat or twisted)...... 14

13b Cells arranged to form a spherical, ovoid or spheroidal colony.. 15

14a Colony horseshoe-shaped, flat or twisted. Fig. 9...*PLATYDORINA*

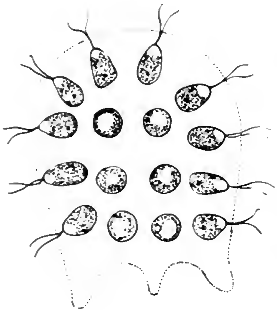

Figure 9

Fig. 9. *Platydorina caudatum* Kofoid. The flagella of the organism in the center of the colony are directed vertically to the surface.

Although rare this plant can be easily identified by the flattened, slightly twisted, horseshoe-shaped colony. It is to be found in the same habitats with other members of the Volvocaceae, *Eudorina* (Fig. 17), and *Pandorina* (Fig. 14).

14b Colony a circular or subquadrangular plate. Fig. 10....*GONIUM*

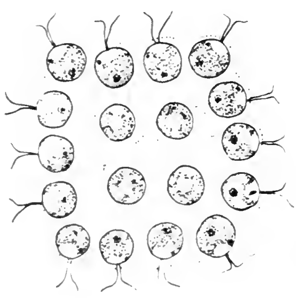

Figure 10

Fig. 10. *Gonium pectorale* Muell. An 18-celled colony.

The number of cells in a colony may vary. Other species (with cells shaped differently) may have as few as 4 or as many as 32-64 individuals. The rectangular plates tumble over and over as the colony swims through the water.

15a Colony oblong or pear-shaped, with cells densely clustered and all directed anteriorly, without an enveloping colonial mucilage.. 16

15b Colony globular or ovoid; cells inclosed in a mucilaginous sheath, but not all directed one way.............................. 18

16a Colonies small (2-4 cells). Fig. 11 .... *PASCHERIELLA*

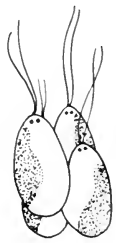

Figure 11

Fig. 11. *Pascheriella tetras* Korsch. Cells showing eye-spot (lateral) and subflagellar vacuoles at the apex.

Rare. Is to be looked for in small rain water pools and catch basins of temporary duration.

16b Colonies of 8-16 cells 17

17a Cells with 4 flagella, arising from a protuberance at the broad end. Fig. 12 .... *SPONDYLOMORUM*

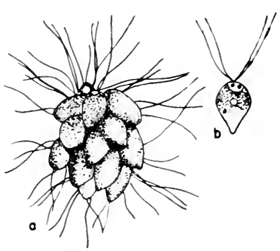

Figure 12

Fig. 12. *Spondylomorum quaternarium* Ehr. a, colony; b. single organism showing posterior eye-spot and subflagellar vacuoles.

Pear-shaped cells huddled together with their broad ends all directed the same way; eye-spot is posterior rather than anterior as in most of its relatives. The 4 flagella are difficult of determination except under favorable optical conditions.

17b Cells with 2 flagella. Fig. 13 .... *CHLAMYDOBOTRYS*

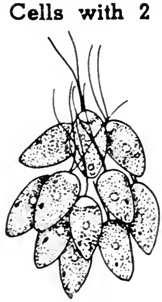

Figure 13

Fig. 13. *Chlamydobotrys gracilis* Korsch. A colony of individuals with posterior eye-spots.

Like *Spondylomorum* (Fig. 12) cells of this colonial organism are closely grouped; have 2 long flagella and a conspicuous eye-spot.

18a (15)—Colony spheroidal or oval; cells pear-shaped, crowded together with broad ends all directed outwardly. Fig. 14.......... ....*PANDORINA*

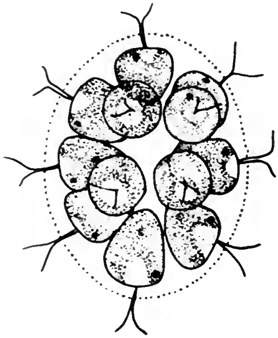

Figure 14

Fig. 14. *Pandorina morum* Bory. Cells are pear-shaped and often are more compactly arranged than shown here.

A tumbling colony in which pear-shaped cells are closely compacted within a spheroidal or oval gelatinous sheath. Often colonies are to be seen in which all individuals have divided to form each a daughter colony. There is one other species in the United States, (possibly a *Eudorina* Fig. 17).

18b Colony globular or broadly ovoid; cells not crowded but evenly spaced (even though close together)..........................19

19a Colonies large, containing hundreds or thousands of cells. Fig. 15 ....*VOLVOX*

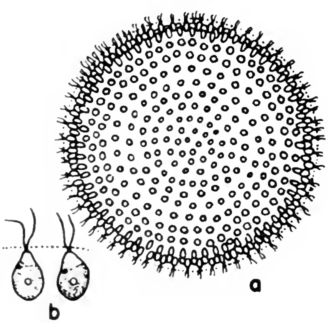

Figure 15

Fig. 15. *Volvox tertius* Meyen. a. Colony showing only vegetative cells; b, two organisms showing eye-spot. Other species have colonies containing a larger number of cells, and some have intercellular connections.

This globular colony containing thousands of cells is usually easily seen with the unaided eye. It occurs in water that is rich in nitrogenous substances (frequently) and sometimes causes "blooms" of short duration (two or three days during summer months).

19b Colonies composed of 8-16-64-128 cells......................20

20a Cells fusiform with sharply pointed lateral processes or extensions of the protoplast. Fig. 16. . . . .*STEPHANOSPHAERA*

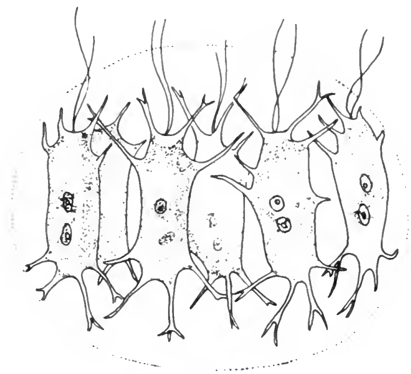

Figure 16

Fig. 16. *Stephanosphaera pluvialis* Cohn. Oval colony with organisms forming a median band. The cells commonly show 2 pyrenoids (starch-storing bodies).

Like *Pascheriella* (Fig. 11) this plant occurs in small, temporary pools; is easily identified by its irregularly shaped cells forming a transverse belt in a compressed, spheroidal gelatinous sheath.

20b Cells round or ovoid, without lateral processes. 21

21a Cells all the same size within the colony. Fig. 17. . . .*EUDORINA*

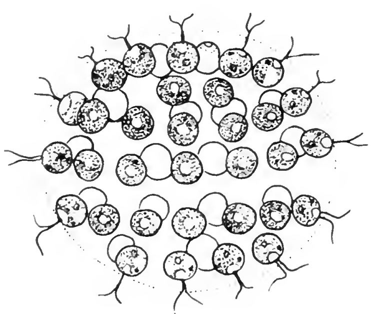

Figure 17

Fig. 17. *Eudorina elegans* Ehr. In this species the cells have a tendency to arrange themselves in transverse bands or tiers. Occurs along with *Volvox* (Fig. 15) and *Pleodorina* (Fig. 18).

Unlike *Pandorina* (Fig. 14) the cells are round or oval and rather evenly spaced within the colonial mucilage. *Eudorina unicocca* G. M. Smith is another species which has been reported from the United States, differentiated by the colony showing a slight polarity with the sheath forming lobes at the posterior end.

21b Cells of 2 sizes within the same colony, the smaller arranged at one pole of the envelope. Fig. 18 . . . . *PLEODORINA*

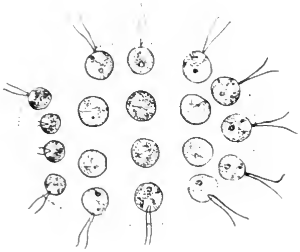

Figure 18

Fig. 18. *Pleodorina illinoisensis* Kofoid. Another common species (*P. californica* Shaw) has about one-half of the cells larger and with reproductive capacity, the smaller cells being strictly vegetative.

Colonies are perfectly spherical like most *Volvox* (Fig. 15) but have many fewer cells (usually 128). Although *Pleodorina* often occurs in the same habitat with *Volvox* it can be distinguished quickly by the two sizes of cells in the colony.

22a (12)—Protoplast at a considerable distance within the cell wall and connected to it by fine, radiating processes; cells with a mass of red pigment often present in the center of the protoplast (sometimes masking the green color); usually encysted, forming rust-colored encrusting growths in bird baths and cemented pools. Fig. 19 . . . . *HAEMATOCOCCUS*

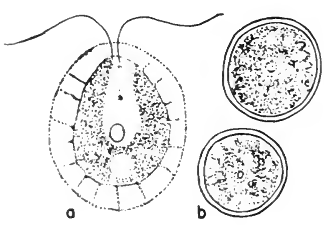

Figure 19

Fig. 19. *Haematococcus lacustris* (Girod.) Rostaf. a, swimming cell showing protoplast with radiating processes; b, cysts (which usually are brick-red in color).

The wide gelatinous wall with fibrils of protoplasm extending out from the cell membrane identify this motile organism. It is widely distributed and a common inhabitor of garden pools and catch basins in rocks.

22b Cells not as above; free-swimming 23

23a Cells with a definite (although sometimes thin) wall, often with a gelatinous sheath 24

23b Cells without a definite wall; chloroplasts lying against the cell membrane; gelatinous sheath wanting 32

24a Cells with 4 flagella 25

24b Cells with 2 flagella 26

25a Cells flattened when seen from the side or from the top. Fig. 20. .... *PLATYMONAS*

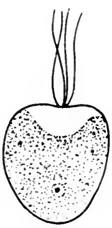

Figure 20

Fig. 20. *Platymonas elliptica* G. M. Smith. (Redrawn from Smith.)

Although usually found in brackish water, this genus contains at least one species that appears in freshwater. To make identification the cells should be seen from the top or side to determine whether they are flattened.

25b Cells round when seen from the side or from the top. Fig. 21.... .... *CARTERIA*

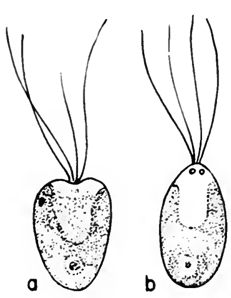

Figure 21

Fig. 21a. *Carteria cordiformis* (Carter) Dies.; b, *Carteria Klebsii* Dill.

Like *Platymonas* (Fig. 20) this genus is characterized by having four flagella but the cells are round when seen in end view. The chloroplast is variable in shape and may not appear as shown in the illustration. It may be a thin plate along the wall, cup-shaped and covering most of the wall except at the anterior end, or H-shaped.

26a Cell wall with lateral, wing-like margins or flanges 27

26b Cell wall smooth, without flanges............................29

27a Envelope roughened or warty, the flanges forming 4 lobe-like extensions when seen from the top or side. Fig. 22...............
....,*WISLOUCHIELLA*

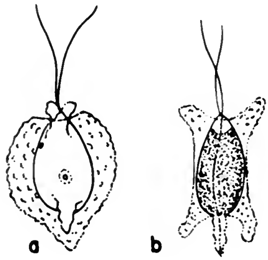

Figure 22

Fig. 22. *Wislouchiella planctonica* Skvor. a, 'front' view; b, side view.

Named for the biologist Wislouch, this biflagellated organism is identified quickly by the oddly-shaped lobes or processes of the wall which extend in several planes. Rare.

27b Envelope not roughened, or if roughened, without lobe-like extensions 28

28a Envelope composed of 2 overlapping pieces, the seam showing when the vegetative cell is seen from the side. Fig. 23.
....*PHACOTUS*

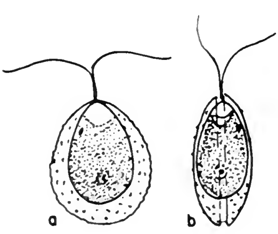

Figure 23

Fig. 23. *Phacotus lenticularis* (Ehr.) Stein. a. 'front' view; b, side view showing bivalve structure of cell wall.

This genus is relatively rare, but is often abundant in collections from habitats where it occurs. It is both euplanktonic (a true plankter) and tychoplanktonic and may occur in river as well as in lake collections.

28b Envelope with 2 overlapping sections which do not show except when the cell is in the process of dividing; envelope 4-angled when seen from the 'front.' Fig 24 .... *PTEROMONAS*

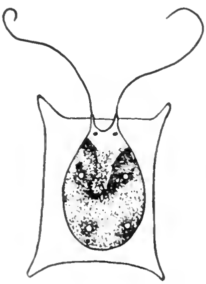

Figure 24

Fig. 24. *Pteromonas aculeata* Lemm.

This genus takes its name from the winged appearance of the envelope. Although there are about 7 species known, the most common perhaps is *Pteromonas aculeata* Lemm. recognizable by the rectangular appearance as seen in 'front' view. Like *Phacotus* (Fig. 23) this species sometimes occurs in the plankton of rivers. See *Scotiella* (Fig. 127), a genus which has been regarded by Pascher as belonging to *Pteromonas*.

29a (26) Cells elongate or fusiform. Fig. 25 .... *CHLOROGONIUM*

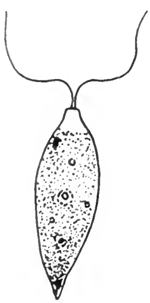

Figure 25

Fig. 25. *Chlorogonium* sp.

Of the 8 species known for this genus only 2 are reported from the United States. They are all more elongate than any other members of the order Volvocales. Usually found in swamps and shallow ponds, they sometimes appear abundantly in laboratory aquaria.

29b Cells round, oval or angular 30

30a Cell wall with lump-like protuberances or short lobes. Fig. 26 .... *LOBOMONAS*

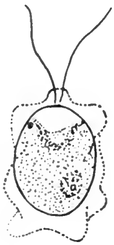

Figure 26

Fig. 26. *Lobomonas rostrata* Hazen.

The irregular lumpy appearance of this genus is its chief characteristic. The organisms appear in the same habitat with *Haematococcus* (Fig. 19), i.e., temporary rain water pools and cement basins.

30b Cell wall without protuberances **31**

31a Gelatinous envelopes shaped similarly to the protoplasts. Fig. 27. .... ***CHLAMYDOMONAS***

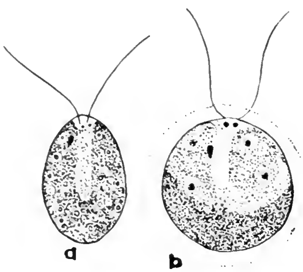

Figure 27

Fig. 27a. *Chlamydomonas polypyrenoideum* Presc.; b, *Chlamydomonas sphagnicola* Fritsch & Takeda, a species with bipapillate protrusions at the anterior end of the sheath.

Whereas this common genus is represented by approximately 175 described species, it is doubtful that they are all distinct. Unless specimens are given careful study they may be confused with other minute biflagellate green cells belonging to other genera, or with zoospores. Variations of the same species may be described under different names. The species of this genus are encountered more frequently than any other members of the Volvocales and are to be found in a great variety of habitats, from the plankton of lakes to the green water of rain barrels. A favorable place for them is the barnyard pool or watering trough. *C. nivalis* (Bauer) Wille produces red snow at high altitudes.

31b Gelatinous envelope and protoplast different in shape from one another. Fig. 28 .... ***SPHAERELLOPSIS***

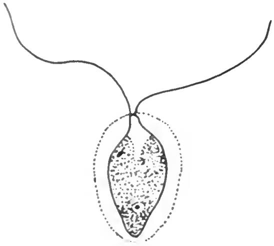

Figure 28

Fig. 28. *Sphaerellopsis fluviatilis* Pascher.

This genus probably should be classified under *Chlamydomonas* although specialists separate its 2 species on the basis of the very wide gelatinous sheath being different in shape from that of the protoplast. It occurs in the tychoplankton of small lakes, and in pools.

32a (23)—Flagella 6-8. Fig. 29 . . . . ***POLYBLEPHARIDES***

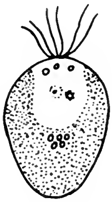

Figure 29

Fig. 29. *Polyblepharides fragariiformis* Hazen, showing 3 of the 4 contractile vacuoles at the anterior end. (Redrawn from Hazen.)

Apparently there are only 2 species on record for this genus. They possess 6-8 flagella and several contractile vacuoles at the anterior end.

32b Flagella 2-4 . . . . **33**

33a Flagella 2 . . . . **34**

33b Flagella 4. Fig. 30 . . . . ***PYRAMIMONAS***

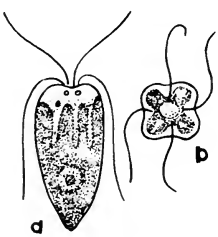

Figure 30

Fig. 30. *Pyramimonas tetrarhynchus* Schmar. a, 'front' view; b, end view showing points of attachment of the flagella.

This is *Pyramidomonas* of some authors; contains at least 8 species all of which are 4-lobed when seen in end view, with a flagellum attached in each of the four depressions between the lobes.

34a Cells ovoid but with lobes or flanges, appearing 6-angled when seen in end view. Fig. 31 . . . . ***STEPHANOPTERA***

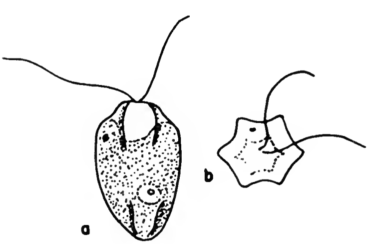

Figure 31

Fig. 31. *Stephanoptera gracilis* (Artari) G. M. Smith. a, 'front' view; b, end view, showing point of attachment of flagella.

This genus takes its name from the fact that it is crown-shaped or 6-lobed when seen on end; the flagella being centrally attached in the anterior end.

34b Cells oblong or ovoid, without lobes. Fig. 32....... ***DUNALIELLA***

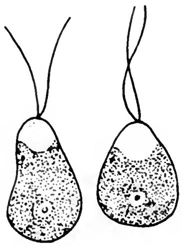

Figure 32

Fig. 32. *Dunaliella salina* Teodor. Two differently shaped individuals.

This species and *D. viridis* Teodor. are apparently the only ones described thus far for the genus, but they are widely distributed judging from reports of them in different parts of the world, occurring in brackish or saline waters.

35a (6). Plant a filament (cells in continuous or interrupted series) with or without branches; or a flat expanse or attached cushion with the branches closely appressed so that the basic filamentous plan is not clearly evident; or a tubular, thread-like thallus without cross walls (coenocytic).................................189

35b Plants not filamentous, but solitary cells or a colony of 2 or more cells inclosed by mucilage or by an old mother cell wall (see *Oocystis*, Fig. 85), or cells variously adjoined to one another (*Scenedesmus*, Fig. 74; *Pediastrum*, Fig. 70)...........................36

36a Cells solitary or gregarious but not adjoined to form colonies...109

36b Cells adjoined or arranged in colonies.......................37

37a Colony composed of 2 trapezoidal cells adjoined along their broad bases. Fig. 33.............................. *EUASTROPSIS*

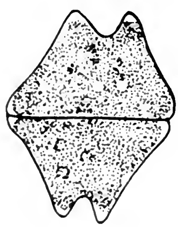

Figure 33

Fig. 33. *Euastropsis Richteri* (Schmid.) Lag.

This is the only species of the genus on record. The two cells which compose the colony appear much like those of *Pediastrum* (Fig. 70) but are never more than this number joined together. *Euastropsis* occurs in the tychoplankton; is rare but widely distributed.

37b Colony composed otherwise 38

38a Colony composed of cells invested by a common mucilage (see *Oocystis*, Fig. 85b, with cells inclosed by old, expanded mother cell wall, not by mucilage) 39

38b Colony composed of an aggregate of cells not inclosed by mucilage, but may be inclosed by old mother cell wall or fragments of it 73

39a Colony attached or adherent 40

39b Colony free-floating or entangled among other algae, but not growing attached (frequently algae usually attached become separated from their substrate. Look for attaching stalk, disc or other evidence of the plant having been once attached) 49

40a Colonies in the form of compact packets among the epidermal cells of aquatic plants. Fig. 34 .... *CHLOROSARCINA*

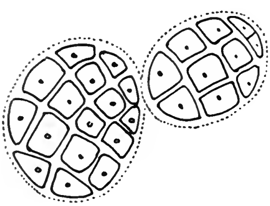

Figure 34

Fig. 34. *Chlorosarcina consociata* (Klebs) G. M. Smith.

This packet-like arrangement of cells is remindful of the genus *Sarcina* among the bacteria. There are 3 species, usually free-living but one that is most frequently seen occurs in the tissues of such aquatic plants as *Lemna*. Old, colorless specimens of *Lemna* often show this and other endophytic algae (*Chlorochytrium Lemnae*, Fig. 94).

40b Colonies not endophytic in the tissues of aquatic plants 41

41a Colonial mucilage sac-like, balloon-shaped or intestiniform, often macroscopic 42

41b Colonial mucilage of other shapes, or if sac-like, microscopic .. 43

42a Aquatic; cells without individual sheaths definitely arranged in 4's (or sometimes in 2's) mostly at the periphery of the common mucilage; under favorable optical conditions often showing long, fine, hair-like extensions (pseudocilia or false flagella). Fig. 35. .... *TETRASPORA*

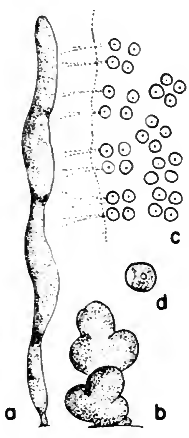

Figure 35

Fig. 35a. *Tetraspora cylindrica* (Wahl.) C. A. Agardh, habit of colony; b, *Tetraspora gelatinosa* (Vauch.) Desvaux, habit of colony; c, arrangement of *Tetraspora* cells; d, single cell showing cup-shaped chloroplast.

Early in the spring or throughout the summer in cold running water gelatinous, balloon-like or intestiniform strands of *Tetraspora* may be found attached to stones or to gravel, sometimes building masses 2 or 3 feet in length. Most of the dozen or so recognizable species are macroscopic but a few appear as microscopic, floating thalli. When the colonies are young and if care is used in obtaining ideal optical conditions, the long fine (often shadowy) pseudocilia are discernible.

42b Terrestrial (usually); cells sometimes with indistinct sheaths, not definitely arranged in 4's; without pseudocilia. Fig. 36......... .... *PALMELLA*

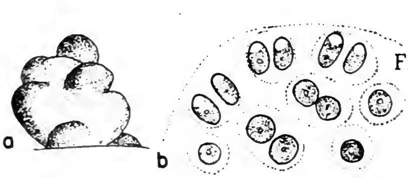

Figure 36

Fig. 36. *Palmella miniata* Liebl. a, habit of colony; b, portion of colony showing arrangement of cells and individual cellular sheaths.

This plant forms lumpy gelatinous masses, 2-8 or more millimeters in diameter on damp soil or on rocks, especially about water falls. The cells of *P. miniata* are often red with the pigment haematochrome, whereas *P. mucosa* (without individual cellular sheaths of mucilage) is always green.

43a (41) Colony balloon-like or pear-shaped, narrowed at base to form a stalk-like attachment; pseudocilia usually visible. Fig. 37.... ....*APIOCYSTIS*

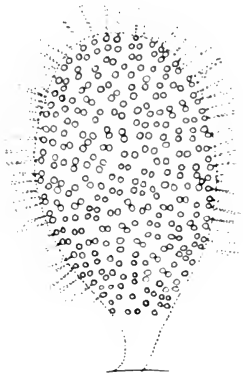

Figure 37

Fig. 37. *Apiocystis Brauniana* Naeg. Diagram of a colony showing cell arrangement and pseudocilia.

This plant is always in the form of a microscopic thallus growing attached to filamentous algae or to stems of aquatic plants. The cells are arranged somewhat irregularly in four's and under favorable conditions show pseudocilia like *Tetraspora*. (Fig. 35.)

43b Colony some other shape; pseudocilia absent..................**44**

44a Colonial mucilage forming a fusiform shaped envelope; cells similarly shaped as the envelope, with long axes more or less parallel. Fig. 38 ....*ELAKATOTHRIX*

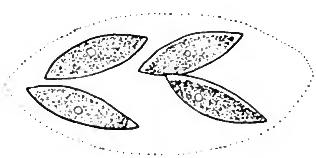

Figure 38

Fig. 38. *Elakatothrix viridis* (Snow) Printz.

Somewhat 'cigar'-shaped cells placed end to end in pairs within a fusiform, gelatinous sheath. *E. gelatinosa* Wille has both ends of the cell pointed whereas other species have the adjoined poles truncate. In one of the three species found in this country, *Elakatothrix americana* Wille, the gelatinous colonial sheath is irregularly lacy or fringed.

44b Colonial mucilage not fusiform..............................**45**

45a Cells cylindrical or elongate-ovoid, scattered throughout amorphous mucilage. Fig. 39 .... *COCCOMYXA*

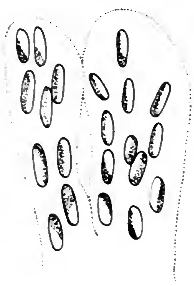

Figure 39

Fig. 39. *Coccomyxa dispar* Schmidle, cells in the tips of gelatinous strands.

There are three recorded species of this genus but only *Coccomyxa dispar* Schm. seems to have been found in this country, forming gelatinous masses of varying extent on damp soil, on wet wood, or more rarely free-floating. It has been found attached in a wooden flume of swiftly flowing water.

45b Cells shaped otherwise 46

46a Cells elliptical or nearly spherical, arranged in 2's and 4's within ungelatinized walls of mother-cell; pigment spot (eye-spot) usually evident. Fig. 40....PALMELLA—STAGE OF *CHLAMYDOMONAS*

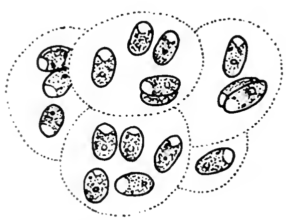

Figure 40

Fig. 40. Palmella-stage of *Chlamydomonas.*

Chlamydomonas (Fig. 27) often becomes quiescent in unfavorable habitats, or as a normal stage in its life history. The cells adhere to a substrate, lose their flagella, but continue to divide, sometimes forming extensive gelatinous masses. The cells are arranged in 2's or 4's and are surrounded by mucilaginous sheaths, thus somewhat resembling *Palmella* (Fig. 36). In this form *Chlamydomonas* is often mistaken for *Gloeocystis* (Fig. 41). Laboratory aquaria often contain *Chlamydomonas* in this stage. The cells may become actively motile again by developing new flagella.

46b Cells spherical (sometimes oval) irregularly scattered throughout mucilage; orange-colored oil globules sometimes present; red eye-spot lacking 47

47a Cells inclosed by concentric layers of mucilage (individual cell sheaths distinct). Fig. 41........................*GLOEOCYSTIS*

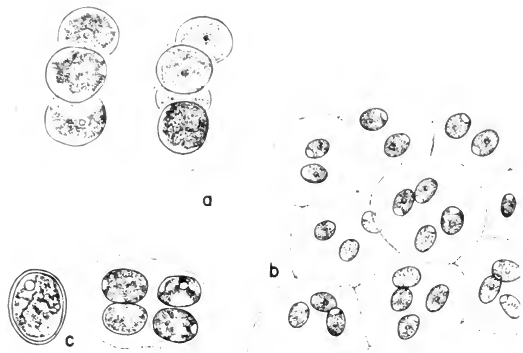

Figure 41

Fig. 41a. *Gloeocystis gigas* (Kuetz.) Lag.; b.*Gloeocystis ampla* (Kuetz.) Lag.; c, *Gloeocystis major* Gerneck, showing dense, cup-shaped chloroplast.

There are several species of *Gloeocystis* and all are very common. They are not very distinctive plants and therefore many small, round green cells, especially when inclosed in mucilage, belonging to other genera may be mistaken for them. The concentric layers of mucilage about the cells provide a helpful character for identification. *Gloeocystis ampla* (Kuetz.) Lag. does not have layers of mucilage, however, but this free-floating species is identified by its oblong or oval cells.

47b Cells without evident individual sheaths; mucilage not in concentric layers 48

48a Chloroplast cup-shaped, not covering the entire wall; cells all the same size within the colonial mucilage. See Fig. 36...*PALMELLA*

This genus has shapeless lumps of attached mucilage, sometimes large enough to be seen easily with the unaided eye. The oval cells scattered throughout the mucilage may have individual sheaths. Like *Gloeocystis* (which also has cup-shaped chloroplasts, Fig. 41) other small, oval cells may be mistaken for *Palmella* and *vice versa*.

48b Chloroplast covering almost the entire wall; cells variable in size within the colonial mucilage. Fig. 42.........*CHLOROCOCCUM*

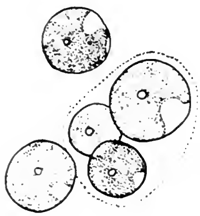

Figure 42

Fig. 42. *Chlorococcum humicola* (Naeg.) Rab. Cells occasionally are seen to be inclosed in a mucilaginous sheath.

Although this plant occurs on soil it reproduces by swimming reproductive cells (zoospores). Another species, *Chlorococcum infusionum* (Schrank) Menegh. is aquatic and is differentiated from *C. humicola* by the fact that its cells are all uniform in size and shape. Old, wet bones, and rocks under dripping water are favorable places for both species. Unless it is *Pleurococcus (Protococcus)*, Fig. 66, *Chlorococcum humicola* is probably the most widely distributed algal species in the world.

49a (39)—Colony fusiform, definite in shape. See Fig. 38..*ELAKATOTHRIX*

49b Colony not fusiform, but cubical, globular quadrate, or irregular in shape..50

50a Colony regularly spherical, oval, or a rectangular plate.......61

50b Colony irregular or some other shape (but young stages of *Tetraspora*, (Fig. 35), may be somewhat spherical)................51

51a Colony of 4 cells in one plane interconnected by strands, the cells bearing a scale-like fragment of mother-cell wall. Fig. 43...*CORONASTRUM*

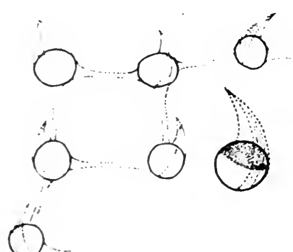

Figure 43

Fig. 43. *Coronastrum aestivale* Thompson. (Redrawn from Thompson.)

This is a very rare alga and the only one of three species in the genus which has been reported from America. The arrangement of the cells and their distinctive wing-like scale make it easy of identification.

51b Colony formed otherwise 52

52a Colony cubical, consisting of 4 cells at the corners of a hollow cube built of gelatinous strands. Fig. 44 . . . . *PECTODICTYON*

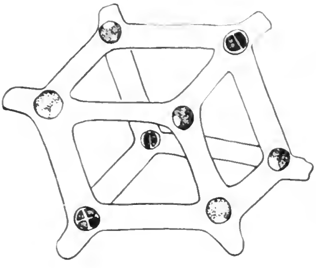

Figure 44

Fig. 44. *Pectodictyon cubicum* Taft. (Redrawn from Taft.)

There is only one species known for this genus and it has been found but once since it was originally described by Taft from Ohio. It is to be expected in open water plankton.

52b Colony formed otherwise 53

53a Cells arranged in a linear series within gelatinous tubes (often branched). Fig. 45 . . . . *PALMODICTYON*

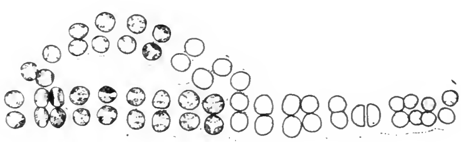

Figure 45

Fig. 45. *Palmodictyon viride* Kuetzing.

This species and *Palmodictyon varium* (Naeg.) Lemm. are fairly common in mixtures of algae from the shallow water of ponds and swamps. The former has cells inclosed in individual sheaths, whereas the latter is without cellular sheaths. Some strands of colonial mucilage may be simple, others irregularly branched and sometimes anastomosing.

53b Cells arranged otherwise 54

54a Cells cylindrical or elongate-ellipsoid 55

54b Cells other shapes **56**

55a Chloroplast axial with one to several pyrenoids. Fig. 46 .... ***MESOTAENIUM***

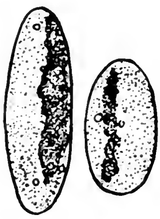

Figure 46

Fig. 46. *Mesotaenium Greyii* Turner (forma), showing variation in cell shape.

These oval or oblong cells have an axial, plate-like chloroplast and a wall that is all in one piece (Saccoderm desmids). Although some of the 5 or 6 species occurring in the country are free-floating, others (*Mesotaenium macrococcum* (Kuetz.) Roy and Biss., e.g.) usually occur among mosses and in various swamp situations. In high mountain seeps they may occur as gelatinous masses on rocks.

55b Chloroplast a parietal plate, without a pyrenoid. See Fig. 39 .... ***COCCOMYXA***

56a Colony forming stringy, intestiniform masses, sometimes perforated skeins. See Fig. 35a .... ***TETRASPORA***

56b Colony shaped otherwise **57**

57a Colony a few (2-4) oval cells inclosed in an irregularly shaped, layered, gelatinous sheath. Fig. 47 .... ***DACTYLOTHECE***

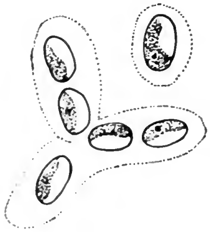

Figure 47

Fig. 47. *Dactylothece* sp.

Cells in this genus are shaped as in *Mesotaenium* (Fig. 46) but they are much smaller (not more than 3 μ in diameter) and have a laminate, parietal chloroplast. The cells are inclosed in mucilage and form thin expanded masses on moist rocks. *D. confluens* (Kuetz.) Hansg. is the only species reported from North America.

57b Colony composed of round or oval cells, gelatinous sheath not stratified 58

58a Semicircular fragments of old mother-cells partly inclosing daughter cells or lying scattered about in the mucilage. Fig. 48........ ....*SCHIZOCHLAMYS*

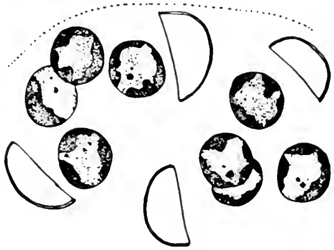

Figure 48

Fig. 48. *Schizochlamys gelatinosa* A. Braun.

At times the free-floating gelatinous masses of this plant may be of macroscopic size and they may be scooped from the surface of the water by hand. More frequently the growths are less extensive and small aggregates of cells occur intermingled with other algae in shallow water situations. The fragments of old mother-cell walls help to identify this plant, and under favorable optical conditions the tuft of fine, gelatinous pseudocilia may be seen.

58b Fragments of old mother-cell walls not apparent..............59

59a Colonies sac-like or irregularly globose; cells arranged in 4's. See Fig. 35b ....*TETRASPORA*

59b Colonies shaped otherwise; cells not arranged in 4's...........60

60a Cells ovoid, compactly arranged in semi-opaque mucilage which is often brown or yellow and obscures the cells; colonies frequently compounded by interconnecting strands of tough mucilage between clusters of cells. Fig. 49...............*BOTRYOCOCCUS*

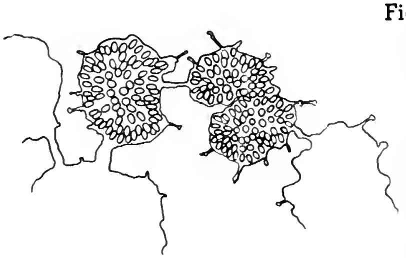

Figure 49

Fig. 49. *Botryococcus Braunii* Kuetz., showing an expression in which a colonial complex is formed by interconnecting strands of tough mucilage. Colonies frequently appear solitary and as a yellowish-brown lump in which individual cells can scarcely be seen, if at all. The color of the colony lies mostly in the mucilage. This species often forms "blooms" especially in hard water lakes.

60b Cells round or oval, not arranged in semi-opaque mucilage. See Fig. 41b .... *GLOEOCYSTIS*

61a (50) Cells incised or constricted in the mid-region to form 'semi-cells', the cells often interconnected by fine gelatinous strands. Fig. 50 .... *COSMOCLADIUM*

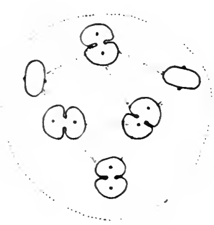

Figure 50

Fig. 50. *Cosmocladium tuberculatum* Presc.

This species has every appearance of a tiny *Cosmarium*-like desmid (Fig. 113) in which the cells are enveloped in a colorless, gelatinous sheath. There are but few species in the genus, occurring with other desmids in soft water or acid bogs. Under favorable optical conditions the fine intercellular connecting strands of mucilage can be determined.

61b Cells not constricted to form 'semi-cells' 62

62a Chloroplast star-shaped, the radiating processes with their outer ends flattened against the wall. Fig. 51 .... *ASTEROCOCCUS*

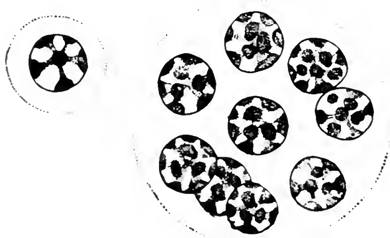

Figure 51

Fig. 51. *Asterococcus superbus* (Cienk.) Scherf.

This species and *A. limneticus* G. M. Smith are the only ones known to occur in North America. *A. superbus* may occur singly or in colonies of 2 or 4 cells and shows the star-shaped chloroplast more clearly than does the former which has smaller cells, 8 to 12, rarely 16 in number within a common envelope. *A. limneticus*, as the name suggests, is found in open water plankton.

62b Chloroplast not star-shaped 63

63a Cells arranged in groups of 4's at the ends of branching mucilaginous strands (focus carefully into the colony). See Fig. 52....64

63b Cells not arranged at the ends of branching strands...........65

64a Cells appearing both reniform (sausage-shaped) and ovoid in the same colony. Fig. 52......................*DIMORPHOCOCCUS*

Figure 52

Fig. 52. *Dimorphococcus lunatus* A. Braun.

In this plant the cells are in clusters of 4, 2 of which when seen in 'top' view appear oval, whereas the others, seen from the side, appear bean-shaped or somewhat crescent-shaped, hence the species name. *Dimorphococcus lunatus* is often abundant in soft water lakes, whereas the other species known from this country, *D. cordatus* Wolle, is less frequently found. Both species may occur in open water plankton or in the tychoplankton near shore. A character that is helpful in identification is a negative one, the absence of a conspicuous gelatinous sheath inclosing the colony.

64b Cells spherical or broadly oval, all the same shape within the colony. Fig. 53............................*DICTYOSPHAERIUM*

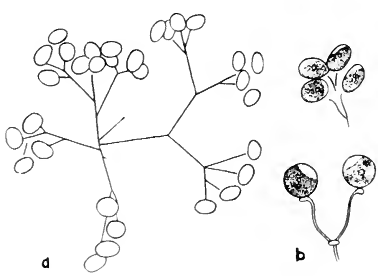

Figure 53

Fig. 53. *Dictyosphaerium pulchellum* Wood. a, Habit of colony; b, Individual cells at ends of radiating strands.

Cells are in clusters of 4, as in *Dimorphococcus* (Fig. 52) but all the same shape, round or oval, smaller in size and often more numerous in the colony which is invested by a colonial mucilage. The radiating, branched thread-like strands are the remains of the old mother-cell wall which has broken down to release daughter-cells.

65a Cells globular 66

65b Cells other shapes, ovoid, fusiform, crescent-shaped, or bean-shaped 68

66a Cells with distinct sheaths; cells inclosed in layered colonial mucilage. See Fig. 41 .... ***GLOEOCYSTIS***

66b Cells without distinct sheaths; colonial mucilage not layered ... **67**

67a Chloroplast cup-shaped with a conspicuous pyrenoid (a doughnut-shaped, starch-storing body, usually shiny); colony often including clusters of smaller daughter cells. Fig. 54 .... ***SPHAEROCYSTIS***

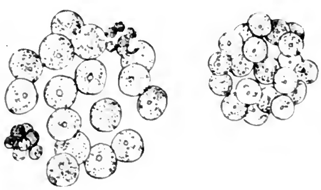

Figure 54

Fig. 54. *Sphaerocystis Schroeteri* Chod.

This plant, of which there is only 1 species in North American records, should be compared with *Planktosphaeria* (Fig. 55). There is 1, cup-shaped choroplast, and the colony almost invariably shows clusters of small cells formed by the division of the parent cell into 4 or 8 daughter-cells. There is a gelatinous sheath but the individual cells do not show the lamellated envelope of *Gloeocystis*, a genus which may be confused with *Sphaerocystis*. Young cells of *Planktosphaeria* may have a cup-shaped chloroplast.

67b Chloroplasts several polygonal plates, each with a pyrenoid (chloroplast single when cells are young); colony not containing clusters of daughter-cells. Fig. 55 .... ***PLANKTOSPHAERIA***

Figure 55

Fig. 55. *Planktosphaeria gelatinosa* G. M. Smith.

This plant, only one species known, occurs mostly in the tychoplankton (shallow water plankton among other algae) but may appear also in the open water plankton (euplankton). Unless care is used it is easy to confuse this plant with *Gloeocystis* (Fig. 41) or *Sphaerocystis* (Fig. 54), or other small, green spherical cells. When mature the cells are recognizable by their angular, 5-sided chloroplasts, each of which contains a pyrenoid. The colonial sheath is often very thin and difficult of determination.

68a (65) Cells lunate or sickle-shaped, tapering and pointed at the apices **69**

68b Cells bean-shaped, oval or spindle-shaped, the apices sometimes tapered but rounded or blunt **70**

69a Cells decidedly curved with the 2 poles nearly touching one another, arranged in scattered groups of 4 with convex walls apposed. Fig. 56 .... *KIRCHNERIELLA*

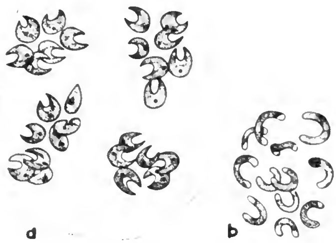

Figure 56

Fig. 56 a, *Kirchneriella lunaris* (Kirch.) Moebius. b, *K. obesa* var. *major* (Ber.) G. M. Smith.

The crescent-shaped or arcuate cells of this genus are inclosed in a (sometimes indistinct) mucilage and are usually found in the open water plankton. There are about 5 species recognized in the United States, showing different degrees of curvature and variations in stoutness. The cells are mostly so sharply curved that their apices nearly touch, whereas in *Selenastrum* (Fig. 67) the cells are symmetrically crescent-shaped. They do not occur in gelatinous envelopes whereas *Kirchneriella* is characterized by the presence of a sheath.

69b Cells symmetrically crescent-shaped, in groups of 4, 2 of which face one another. Fig. 57...................... *TETRALLANTOS*

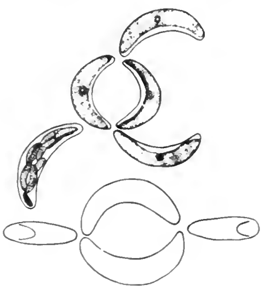
Figure 57

Fig. 57. *Tetrallantos Lagerheimii* Teiling.

This rare species (the only one in the genus) is widely distributed. The characteristic arrangement of the cells is determined at the time that they are formed in groups of 4 within the mother-cell. After the mother-cell wall breaks down to release the daughter-cells fragments of the wall may persist as interconnecting or radiating threads within the colonial mucilage which is often very thin and difficult of determination.

70a Cells fusiform or spindle-shaped............................. 72

70b Cells ovate, bean-shaped, or oblong.......................... 71

71a Cells oval, somewhat irregularly arranged in 4's, forming a flat plate. Fig. 58.................................. *DISPORA*

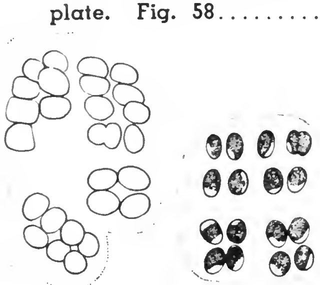
Figure 58

Fig. 58. *Dispora crucigenioides* Printz.

Only 1 species in the United States, and apparently rare. The cells are in rather irregular rectilinear series and usually show a quartet arrangement within a flat gelatinous sheath. It should be compared with *Crucigenia* (Fig. 72), especially *C. irregularis* in which the cells are more definitely arranged in 4's.

71b Cells bean-shaped or oblong, reproducing by autospores which are retained within the enlarged mother-cell wall (the wall may gelatinize and appear as a mucilaginous sheath). Fig. 59.......... .... ***NEPHROCYTIUM***

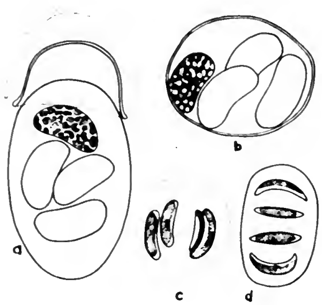

Figure 59

Fig. 59 a, *Nephrocytium ecdysiscepanum* W. West; b, *N. obesum* W. & G. S. West; c, *N. limneticum* (G. M. Smith) G. M. Smith; d, *N. lunatum* W. West.

Most of the five species of this genus which occur in the United States have reniform or bean-shaped cells, often with one convex wall and one flattened or less convex than the other. They occur in mixtures of algae in the tychoplankton but two species of the genus, *N. Agardhianum* Naeg. and *N. limneticum* G. M. Smith are usually found in the euplankton. The former has elongate, almost vermiform cells which are sometimes curved or spirally twisted.

72a Cells in linear pairs, 1 or several pairs within a common mucilaginous investment (cells with long axes approximately parallel, sometimes solitary). See Fig. 38..................... ***ELAKATOTHRIX***

72b Cells arranged in parallel bundles, reproducing by autospores (daughter colonies forming within the mother-cell). Fig. 60..... .... ***QUADRIGULA***

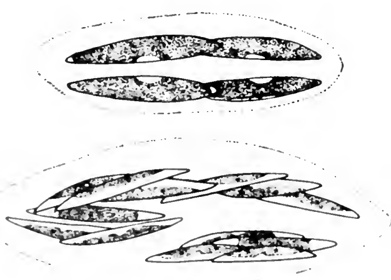

Figure 60

Fig. 60. *Quadrigula Chodati* (Tanner-Fullman) G. M. Smith.

There are 3 species found in the euplankton of lakes, all of which have elongate,fusiform or 'cigar'-shaped cells. The species illustrated has cells with bluntly rounded poles whereas the other two have pointed apices. The cells occur in rather compact bundles of 4, all lying parallel in the colonial envelope.

73a (38) Cells (or some of them in the colony) bearing long, gelatinous bristles or scales, or hairs................................74

73b Cells without bristles but some with spines shorter or longer than the cell 76

74a Cells arranged in a quadrate colony of 4 cells interconnected by strands, each cell bearing a scale-like fragment of mother-cell wall. See Fig. 43 . . . . *CORONASTRUM*

74b Colony formed otherwise 75

75a Cells forming an attached, compact cluster within the mother-cell wall which bears a branched hair that has no sheath. Fig. 61. . . . . *DICRANOCHAETE*

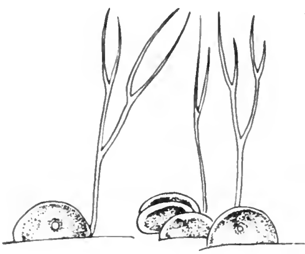

Figure 61

Fig. 61. *Dicranochaete reniformis* Heiron.

Although this curious plant usually occurs as single cells, the individuals may be clustered as a result of recent cell division. It grows on filamentous algae and other submerged aquatic plants and apparently is very rare. The unique branched seta which is produced from the lower side of the cell makes identifications certain.

75b Cells loosely arranged side by side in a cluster, each bearing an unbranched hair with a basal sheath. Fig. 62. . . . . *CHAETOSPHAERIDIUM*

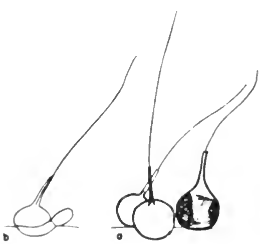

Figure 62

Fig. 62. *Chaetosphaeridium globosum* (Nordst.) Klebahn. a, group of cells; b, one cell showing tube-like utricle which may extend from one cell to another and so form a sort of colony.

This globular, hair-bearing cell occurs either singly or in aggregations of 2 to 8 individuals on larger algae, on *Utricularia* or on other aquatic plants. This genus and *Dicranochaete* (Fig. 61) are anomalous members of a family of filamentous algae. Their inclusion in the Coleochaetaceae is based upon the type of seta (a bristle with a sheathed base) which they have in common.

76a (73) Cells attached at the ends of branching gelatinous stalks, epizoic on microcrustaceans 77

76b Cells not at the ends of branching gelatinous strands; not epizoic . 78

77a Cells ellipsoid or somewhat fusiform; chloroplast 1 or 2 longitudinal lateral bands. Fig. 63 .... *CHLORANGIUM*

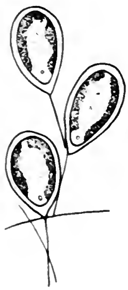

Figure 63

Fig. 63. *Chlorangium stentorinum* (Ehr.) Stein.

This organism becomes attached, anterior end down, to small crustaceans and other microscopic animals by means of a gelatinous stalk. Although a swimming cell, the flagella are thrown off and the organism continues to divide, the stalk becoming branched as new individuals arise so that a colony results. Some small animals such as *Cyclops* may go swimming about with veritable plumes of the green cells growing on their antennae. The cells have 2 elongate, parietal chloroplasts. Compare *Chlorangium* with *Colacium* (Fig. 64).

77b Cells ovate to oblong or ovoid; chloroplasts numerous ovoid discs. Fig. 64 .... *COLACIUM*

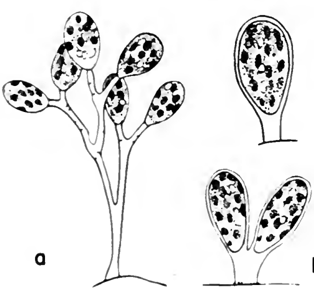

Figure 64

Fig. 64 a, *Colacium arbuscula* Stein; b, *C. vesiculosum* Ehr.

Microscopic animals, especially crustaceans, may appear green because of the large numbers of *Colacium* individuals attached to them, either singly or in plume-like clusters. Like *Chlorangium* (Fig. 63) this organism is a motile green cell which, however, has numerous *Euglena*-like chloroplasts (Fig. 8) and a conspicuous red pigment-spot. The rather specific association of the algal cells with the animal host incites speculation as to how this relationship is maintained.

78a (76) Cells ellipsoid or spindle-shaped, attached end to end forming loose branching chains. Fig. 65 .... *DACTYLOCOCCUS*

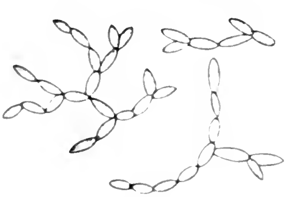

Figure 65

Fig. 65. *Dactylococcus infusionum* Naeg. (Redrawn from Smith.)

This anomalous genus is known from soil collections of algae. The characteristic chain-like arrangement of the cells develops as the cells are cultivated whereas they probably are solitary in nature.

78b Cells not arranged in branching chains 79

79a Cells globose or flattened on some sides from mutual compression; forming green films on moist substrates. Fig. 66 .... *PROTOCOCCUS*

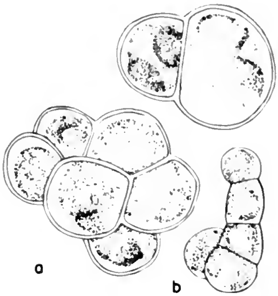

Figure 66

Fig. 66. *Protococcus viridis* Ag. a, clump of cells; b, filamentous tendency in cell arrangement.

This plant, also known the world over as *Pleurococcus vulgaris* Menegh., forms the familiar green film on the moist side of trees, rocks, wet boards, etc. Essentially unicellular, it forms clumps from repeated cell division and the occasional tendency to form filaments has led students of the algae to classify it in the filamentous order, Ulotrichales, and to consider it as having been reduced to its present simple morphological condition. It reproduces only by cell division and is easily distributed by wind, water, and insects so that it appears throughout the world almost everywhere that subaerial life can exist.

79b Cells differently shaped, not producing films on aerial substrates . 80

80a Cells crescent-shaped or sharply acicular (needle-shaped) 81

80b Cells some other shape 82

81a Cells strongly crescent-shaped, closely clustered but not entangled. Fig. 67 .... *SELENASTRUM*

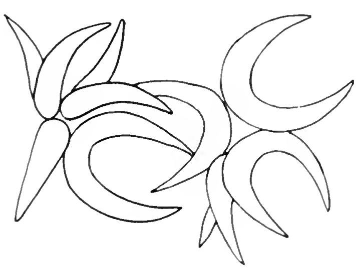

Figure 67

Fig. 67. *Selenastrum gracile* Reinsch.

These gracefully curved cells occur in clusters of from 4 to 32, with a tendency to have the convex or 'outer' walls approximated. The curvature of the 'outer' and 'inner' walls of the crescent are more nearly the same than in the somewhat similarly shaped cells of *Kirchneriella* (Fig. 56), a genus which has cells irregularly arranged within a gelatinous envelope. Four species are commonly found in this country, mostly differentiated by size and degree of curvature. Mixtures of algae from shallow water situations often include *Selenastrum* but they may be found also in the euplankton.

81b Cells straight or only slightly crescent-shaped, loosely entangled about one another (frequently solitary rather than colonial). Fig. 68 .... *ANKISTRODESMUS*

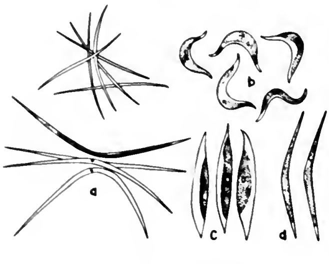

Figure 68

Fig. 68a. *Ankistrodesmus falcatus* (Corda) Ralfs; b. *A. convolutus* Corda; c, *A. Braunii* (Naeg.) Brunn.; d, *A. fractus* (W. & G. S. West) Brunn.

Although there are 5 or 6 species of this genus common in the United States, *A. falcatus* (Corda) Ralfs is probably the one most frequently collected. It occurs as solitary or loosely clustered needles or slightly fusiform-shaped cells intermingled with other algae, or sometimes forming almost pure growths in artificial pools or in laboratory aquaria. One species, *A. spiralis* (Turn.) Lemm., has needle-shaped cells spirally twisted about one another to form bundles.

82a (80) Cells attached either along their side or end walls to form definite patterns, nets, plates, triangular clusters, or short rows..83 end only in juxtaposition. See Fig. 57........... *TETRALLANTOS*

82b Cells attached otherwise, if adjoined by lateral walls then not forming definite patterns...................................98

83a Cells cylindrical, one cell attached by 2 others at the end walls repeatedly to form a network. Fig. 69.......... *HYDRODICTYON*

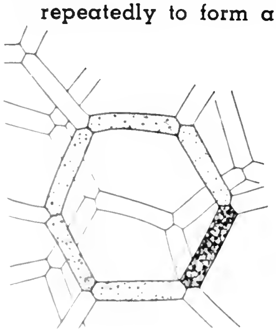

Figure 69

Fig. 69. *Hydrodictyon reticulatum* (L.) Lagerheim.

This is the familiar "water-net" which often grows in such dense mats in lakes, small ponds and irrigation ditches as to become a troublesome weed. This unique alga is able to reproduce very rapidly because each cell of the net in turn produces a new cylindrical net of small cells within it, which upon escape enlarge enormously, each cell again producing a net. The nets are of macroscopic size and there is a report of one being found more than 2 feet in length. It is thought that the first written records referring to a specific alga is of *Hydrodictyon* in ancient Chinese literature.

83b Cells some other shape, not attached to form a network.......84

84a Cells arranged to form flat, circular or rectangular plates. (Fig. 70) 85

84b Cells not arranged to form flat plates........................88

85a Cells forming circular plates (sometimes irregularly subcircular), the marginal cells sometimes different in shape from those within. Fig. 70 ....*PEDIASTRUM*

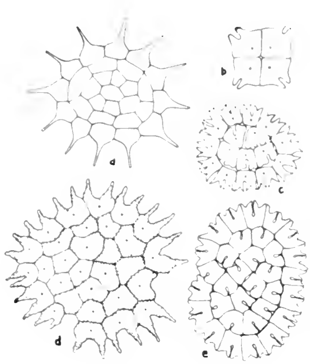

Figure 70

Fig. 70 a, *Pediastrum simplex* (Meyen) Lemm.; b, *P. tetras* (Ehr.) Ralfs; c, *P. biradiatum* var. *emarginatum* fa. *convexum* Pres.; d. *P. Boryanum* (Turp.) Menegh.; e, *P. obtusum* Lucks.

Although there are many species of this genus all may be identified by the plate-like arrangement of cells. The plate may be continuous with internal cells different in shape from those at the periphery, or there may be interstices with all cells in the colony about the same shape. One, *P. tetras* (Ehr.) Ralfs, forms plates of but 4 cells. Rarely a 2-celled colony may appear, in which case it might be mistaken for *Euastropsis* (Fig. 33).

85b Cells not arranged to form circular plates....................86

86a Cells triangular or ovoid, forming quadrangular plates, bearing one or more spines. Fig. 71......................*TETRASTRUM*

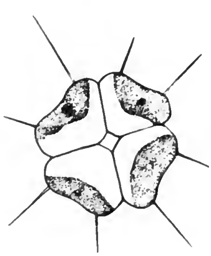

Figure 71

Fig. 71. *Tetrastrum heterocanthum* (Nordst.) Chod.

There are probably only three species of this genus reported from the United States. They occur in the euplankton and are readily identified by their arrangement in flat plates of four, the cells bearing 1 to 4 spines on the outer free walls.

86b Cells rectangular or trapezoidal or if oval, without spines......87

87a Cells rectangular, oval, or trapezoidal, the outer walls entire (not incised); arranged to form quadrate plates in 4's or in multiples of 4. Fig. 72 .... *CRUCIGENIA*

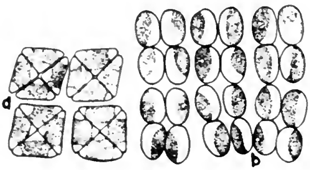

Figure 72

Fig. 72 a, *Crucigenia tetrapedia* (Kirch.) W. & G. S. West; b, *C. rectangularis* (A. Braun) Gay.

These cells (like *Tetrastrum*, Fig. 71) occur in 4's but usually form multiple colonies of rectangular plates. There are about a dozen species in the United States, differentiated by the shape of the cell which may be oval, triangular or elliptic in outline.

87b Cells trapezoidal, the outer free walls deeply incised, forming oval or somewhat angular plates (only 4 cells present in some colonies). See Fig. 70 .... *PEDIASTRUM*

88a (84) Cell walls with spines 89

88b Cell walls without spines 92

89a Cells ellipsoid, spines numerous, needle-like; cells (usually solitary) arranged side by side because of interlocking spines, indefinite in number. Fig. 73 .... *FRANCEIA*

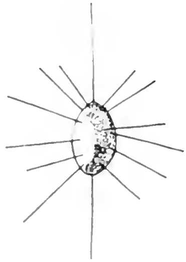

Figure 73

Fig. 73. *Franceia Droescheri* (Lemm.) G. M. Smith.

This and two other species occur in the euplankton of lakes but rather rarely. The cells are solitary but they may be clustered from the interlocking of the needle-like spines which cover the wall. *Lagerheimia* (Fig. 118) has a similar shape and needle-like spines that are confined to the poles or to the mid-region of the cell.

89b Cells ovoid or spherical; spines few (1-4), cells definitely arranged and definite in number 90

90a Cells ovoid, arranged side by side in one or two alternating rows; spines short, mostly arising from the poles of the cells only. Fig. 74. .... *SCENEDESMUS*

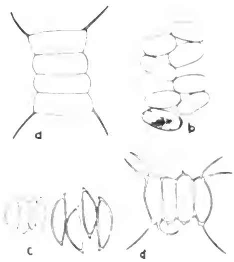

Figure 74

Fig. 74. a, *Scenedesmus quadricauda* (Turp.) de Breb.; b, *S. bijuga* var. *alternans* (Reinsch) Hansg.; c. *S. incrassatulus* var. *mononae* G. M. Smith (Redrawn from Tiffany); d, *S. opoliensis* P. Richter.

There are numerous species of this genus occurring both in the euplankton and the tychoplankton (intermingled, free-floating algae in shallow water near shore). The cells are oval, fusiform, or crescent-shaped according to species, and occur side by side in one series of 4, or in a double, alternating series of 8; rarely a single series of cells will have 8 or 12 cells. Certain species of *Scenedesmus* invariably appear in laboratory cultures, often coloring the water green. Under unnatural conditions the cells often appear singly rather than in colonies of 4. Perhaps the most common species is *S. quadricauda* (Turp.) de Breb in which the two outer cells of the series bear a long curved spine at their poles.

90b Cells spherical, in groups of 4 or in multiples of 4 to form compound colonies, outer walls bearing long, slender spines.......91

91a Colony triangular, spines 1-7. Fig. 75.......... *MICRACTINIUM*

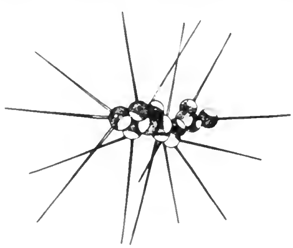

Figure 75

Fig. 75. *Micractinium pusillum* Fres.

This rare alga occurs in the euplankton, having clusters of 4 round cells arranged in the form of a pyramid. Each cell bears 1 to several long, tapering spines. Another species which is also seldom seen is *M. quadrisetum* (Lemm.) G. M. Smith, having oval or elliptic cells.

91b Colony pyramidal but with outer wall bearing a single stout spine. Fig. 76.. *ERRERELLA*

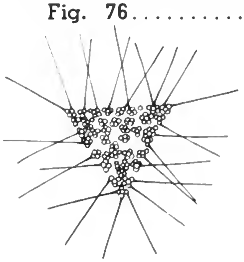

Figure 76

Fig. 76. *Errerella bornhemiensis* Conrad.

Cells of this plant, of which there is but a single species, are arranged to form a 3-dimension pyramid. It is known only from the euplankton and apparently is very rare.

92a (88) Cells spherical or polygonal, arranged to form hollow, spherical or many-sided colonies; cells adjoined by interconnecting protuberances of the mucilaginous sheath. Fig. 77....*COELASTRUM*

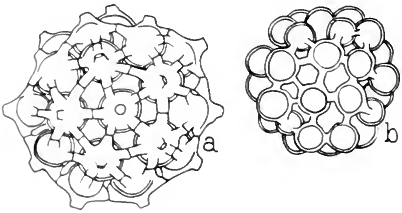

Figure 77

Fig. 77 a, *Coelastrum cambricum* Archer (Redrawn from Smith); b, *C. microporum* Naegeli.

As the name suggests, cells of this plant are arranged to form a hollow colony. Six or seven species are known from this country, differing in the shape of the cell and in the length of the interconnecting processes. Common in both euplankton and in the tychoplankton.

92b Cells not forming hollow colonies and not so adjoined..........93

93a Cells fusiform, radiating from a common center. Fig. 78..*ACTINASTRUM*

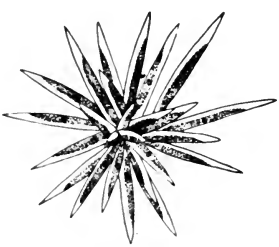

Figure 78

Fig. 78. *Actinastrum Hantzschii* Lag.

These "cigar"-shaped cells are arranged in radiating colonies. This species is more common in the plankton than is *A. gracillimum* G. M. Smith which has pointed rather than truncate apices.

93b Cells shaped otherwise, not forming a colony of radiating cells..94

94a Cells ellipsoid to fusiform, adjoined end to end, forming chain-like series. See Fig. 65..........................*DACTYLOCOCCUS*

94b Cells not forming chains.................................95

95a Cells ovoid, ellipsoid or fusiform, adjoined by their lateral wall to form a row of 4 in a single series, or a double series in which the cells are alternating. See Fig. 74................*SCENEDESMUS*

95b Cells globular or variously shaped, not attached side by side in one plane 96

96a Cells fusiform or trapezoidal, attached with their long axes parallel about a common center. Fig. 79..............*TETRADESMUS*

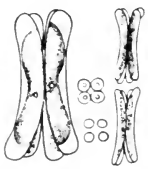

Figure 79

Fig. 79. *Tetradesmus Smithii* Presc.

This plant resembles some *Scenedesmus* species (Fig. 74) but differs in having the cells quadrately arranged rather than in a series in one plane. There are but two species known in this country, both of them from the euplankton of Wisconsin lakes. *T. wisconsinense* G. M. Smith has trapezoidal cells.

96b Cells some other shape and not attached about a common center.97

97a Cells crescent-shaped, in groups of 4, 2 with concave sides toward one another, the other 2 cells in another plane with poles at one end only in juxtaposition. See Fig. 57...........*TETRALLANTOS*

97b Cells sickle-shaped, fusiform or crescent-shaped, twisted about one another. See Fig. 68.........................ANKISTRODESMUS

98a (82) Cells adjoined by gelatinous strands or threads formed from the remains of old mother-cell walls..........................99

98b Cells not adjoined by remains of old mother-cell walls........101

99a Cells spindle-shaped, in clusters of 4-8-16 at the ends of radiating gelatinous stalks. Fig. 80.......................*ACTIDESMIUM*

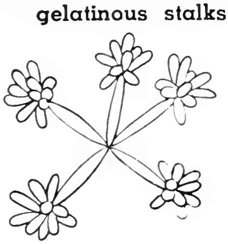

Figure 80

Fig. 80. *Actidesmium Hookeri* Reinsch.

This rare plant occurs in the tychoplankton of shallow pools. The star-shaped clusters of cells at the ends of radiating (sometimes dichotomously branched) gelatinous stalks render it easy of identification.

99b Cells shaped or arranged otherwise **100**

100a Cells globose, in clumps of 4-8, the groups held together by loop-like fragments of old mother-cell wall. Fig. 81 . . . . . . **WESTELLA**

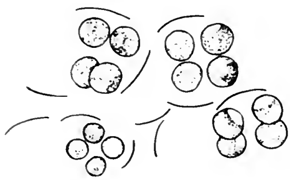

Figure 81

Fig. 81. *Westella botryoides* (W. West) de Wild.

This plant should be compared with *Dictyosphaerium* (Fig. 53) which it may resemble superficially at times. *Westella* has no gelatinous envelope and although there are strands left by the old mother-cell wall they do not produce the regular radiate structures as in *Dictyosphaerium.*

100b Cells appearing oval and bean-shaped in the same colony, in clusters at the ends of radiating, branched strands. See Fig. 52. . . . . ***DIMORPHOCOCCUS***

101a (98) Cells pear-shaped, bean-shaped, or somewhat crescent-shaped, the outer free wall bearing 2 to 4 stout spines; cells arranged at the ends of radiating, stout, gelatinous strands to form a globular colony. Fig. 82 . . . . ***SORASTRUM***

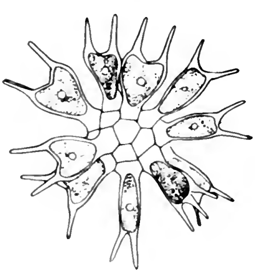

Figure 82

Fig. 82. *Sorastrum americanum* (Bohlin) Schmidle.

There are only 2 species of this genus reported from the United States, of which *S. spinulosum* Naeg. is probably the more common in the plankton. This species has relatively stout short spines and the basal pedicel is scarcely developed so that the colony appears as a compact cluster.

101b Cells not so arranged, without spines or with spines different than above **102**

102a Cells spherical or oval, in 2's and 4's, separated from one another by semi-opaque masses of dark mucilage which form X-shaped bands. Fig. 83 .... *GLOEOTAENIUM*

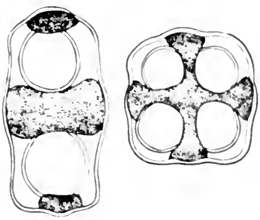

Figure 83

Fig. 83. *Gloeotaenium Loitelsbergerianum* Hansg.

This unique plant is rare but widely distributed. When it occurs at all it is relatively abundant. Collections from the mixture of algae in shallow water ponds and bogs often yield this species.

102b Cells not separated from one another by masses of dark mucilage 103

103a Cells bearing long, needle-like spines (colonial only because of entangled spines). Fig. 84 .... *GOLENKINIA*

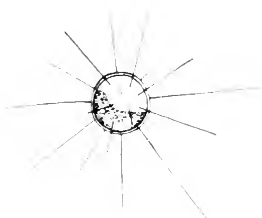

Figure 84

Fig. 84. *Golenkinia radiata* (Chodat) Wille.

There are but 2 species of this genus reported, both of them common in two samples from the open water of lakes. G. *radiata* Chod. has spines 2 to 3 times the diameter of the cell in length, whereas G. *paucispina* West & West has more numerous spines that are about equal to the cell diameter in length.

103b Cells without spines 104

104a Cells inclosed by old mother-cell wall 105

104b Cells not inclosed by old mother-cell wall 106

105a Cells somewhat bean-shaped or kidney-shaped, or broadly elliptic (old mother-cell wall often appearing as a mucilaginous sheath). See Fig. 59 .... *NEPHROCYTIUM*

105b Cells elliptic, lemon-shaped, or nearly cylindrical, 1 to several generations of mother-cell walls inclosing daughter cells. Fig. 85. .... *OOCYSTIS*

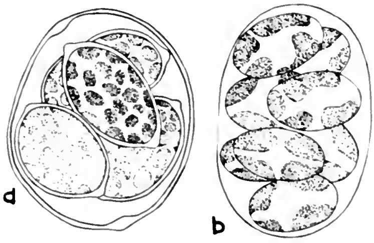

Figure 85

Fig. 85. a, *Oocystis Eremosphaeria* G. M. Smith; b, *O. Borgei* Snow.

There are several species of this genus common in both the euplankton and the tychoplankton. The various forms are differentiated by the presence or absence of nodules at the poles and by the number of chloroplasts. Two or 3 generations of cell walls may be inclosed within an original mother-cell wall which enlarges so that it often appears as a gelatinous sheath and is, therefore, misleading as a differentiating genus character.

106a Cells spherical, occurring as evenly distributed clumps within the gelatinous sheaths which sometimes are lacking; chloroplasts several angular plates. See Fig. 55.......... *PLANKTOSPHAERIA*

106b Cells variously shaped but not distributed in clumps as above; often densely aggregated; chloroplast 1, parietal............. 107

107a Cells spherical or angular from mutual compression when occurring in clumps; subaerial................................ 108

107b Cells fusiform or needle-shaped, aquatic. See Fig. 68........ .... *ANKISTRODESMUS*

108a Cells spherical, clustered but not adjoined, sometimes solitary. See Fig. 42............................. *CHLOROCOCCUM*

108b Cells in dense clumps, forming a film or a layer on moist subaerial substrates; cells spherical or angular from mutual compression. See Fig. 66........................ *PROTOCOCCUS (PLEUROCOCCUS)*

109a (36) Cells crescent-shaped, or sickle-shaped, with sharply pointed or narrowly rounded and tapering apices.................. 110

109b Cells some other shape....................................... 117

110a With 2 axial chloroplasts bearing longitudinal ridges, a chloroplast in either horn of the cell; pyrenoids conspicuous, usually in an axial row. Fig. 86 .... *CLOSTERIUM*

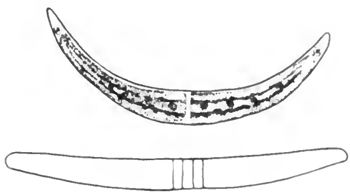

Figure 86

Fig. 86. *Closterium spp.* Two of the many variations in curvature and cell proportions exhibited in this genus.

This desmid usually has distinctly crescent-shaped cells, but some species are nearly straight, or have the outer margin of the cell bowed and the inner almost straight. A few species have the poles extended to form long, almost straight, needle-like processes which are swollen at the tip. Although this genus does not show the constriction of the cell to form two semi-cells characteristic of most other true desmids, the cell contents are symmetrically divided into 2 portions with the nucleus centrally located. A never-failing characteristic of *Closterium* is the polar vacuoles containing vibrating granules of gypsum.

110b Cells with 1 chloroplast, or with parietal chloroplasts not arranged as above 111

111a Cells only slightly crescent-shaped, (usually straight or nearly so, and often irregularly curved), with poles drawn out into fine points 112

111b Cells definitely crescent-shaped, or with poles not drawn out into fine points 114

112a Cells attached by a slender stipe to other algae or to microfauna. Fig. 87 .... *CHARACIUM*

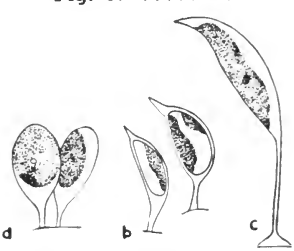

Figure 87

Fig. 87. a, *Characium Debaryanum* (Reinsch) DeToni; b, *C. ornithocephalum* A. Braun; c, *C. rostratum* Reinhard.

There are numerous species in this genus, differentiated by shape of cell and by presence or absence of a stalk. Some are very minute and are easily overlooked, whereas others are larger and grow in associations so as to form conspicuous patches on filaments of algae or on small animals. The genus *Characiopsis* contains species shaped like some of those of *Characium* and care should be used in determining the color of the chloroplast and the presence or absence of a pyrenoid in making identification. *Characiopsis* (Fig. 217) has a yellow pigment predominating and starch tests are negative; is a member of the Chrysophyta.

112b Cells not attached by a stipe 113

113a **Wall at the poles of the cell extended to form slender setae, one of which may be forked; cholorplasts extending the full length of the cell. Fig. 88 . . . . *SCHROEDERIA***

Figure 88

Fig. 88. *Schroederia Judayi* G. M. Smith.

One of the three species found in the United States, *S. setigera* (Schrod.) Lemm., is the most common. The cells have a spine at both poles which is undivided, whereas *S. ancora* G. M. Smith, also fairly common in plankton, has one polar process forked at the tip. In a Michigan pond the former species occurred as practically the only member of the plankton throughout winter months.

113b **Tips of the cells narrowed to fine points at least at one end with the poles narrowly rounded, tip not seta-like but narrowly pointed; chloroplast not extending the full length of the cell. Fig. 89. . . . . *OUROCOCCUS***

Figure 89

Fig. 89. *Ourococcus bicaudatus* Grob. (Redrawn from Smith.)

This rare plant might be confused easily with *Ankistrodesmus* spp. (Fig. 68) but the cells are usually stouter. It is closely related to *Elakatothrix* (Fig. 38) in the Order Tetrasporales because the cells retain the ability to divide vegetatively to form new individuals, whereas in the Order Chlorococcales, which concerns cells similar in shape to *Ourococcus*, the cells cannot undergo division but must form new individuals within the wall of the parent cell.

114a **(111) Cells very slender, needle-like or sometimes fusiform (usually in clusters but sometimes solitary), often only slightly crescent-shaped; chloroplast parietal, the outline often discerned with difficulty. See Fig. 68 . . . . *ANKISTRODESMUS***

114b **Cells stouter, not needle-like; definitely crescent-shaped, the chloroplast parietal and definite in outline 115**

115a Cells bearing a stout spine at either end. Fig. 90 . . . . *CLOSTERIDIUM*

Figure 90

Fig. 90. *Closteridium lunula* Reinsch.

This species has two relatives which are nearly straight. It can be differentiated from *Closterium* (Fig. 86) by the fact that there is but a single chloroplast, and by the absence of the terminal vacuoles with vibrating granules.

115b Cells without stout spines at the ends 116

116a Cells inclosed in a mucilage (usually in clusters but sometimes solitary); in some species the curvature is so great that the tips nearly touch. See Fig. 56 . . . . *KIRCHNERIELLA*

116b Cells not inclosed in mucilage (rarely in mucilage; see Fig. 67): usually in clusters but sometimes found solitary; curvature of the inner margin nearly that of the outer; tips of cell not almost touching. See Fig. 67 . . . . *SELENASTRUM*

117a (109) Living in the tissues of higher plants or in animals 118

117b Not living in tissues of plants or in animals 121

118a Cells globose, numerous within protozoa, sponges, *Hydra*, et al. Fig. 91 . . . . *CHLORELLA*

Figure 91

Fig. 91. a, *Chlorella (Zoochlorella) parasitica* Brandt (in *Ophrydium*, a colonial ciliate); b, *C. (Zoochlorella) conductrix* Brandt (in *Hydra)*; c, *C. ellipsoidea* Gerneck, two cells enlarged to show parietal chloroplasts.

These small cells occur singly or in gregarious masses, either free-living or contained within the bodies of animals such as protozoa and sponges. As endozoic plants they are often known as *Zoochlorella*. Species are not well-defined and mostly are differentiated by size. The chloroplast is thin and cup shaped. Like other members of the Chlorococcales, reproduction takes place by internal cell division (in this case forming non-motile autospores). *Chlorella* is a genus that has been and is now being used in culture for investigations of the process of photosynthesis and the synthesis of proteins.

118b Cells some other shape; not living within animals...........119

119a Plant a much-branched, coenocytic tube (multi-nucleate and without cross walls), growing in leaves of Araceae (Indian Turnip). Fig. 92.....................................*PHYLLOSIPHON*

Figure 92

Fig. 92. *Phyllosiphon Arisari* Kuhn. a, portion of thallus showing tangled threads; b, habit of thallus in tissue of host (redrawn from Just).

This branched, tubular plant is non-cellular; forms green patches in the leaves of higher plants which become discolored. It may be more widely distributed than appears to be the case at present, but so far it is known only from northern and eastern sections of the United States.

119b Plant not a branched coenocyte.............................120

120a An irregularly shaped, flask-like cell in the tissues of *Ambrosia* (ragweed), and other plants. Fig. 93........*RHODOCHYTRIUM*

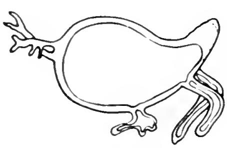

Figure 93

Fig. 93. *Rhodochytrium spilanthidis* Lag.

This curiously shaped, unicellular parasite occurs on a greater variety of hosts than *Phyllosiphon* (Fig. 92), but seems to be most frequent in ragweed. It is quickly identified by the red color and the large number of strach grain that are usually present.

120b An irregularly oval, thick-walled cell in the tissues of *Lemna* (duckweed). Fig. 94......................*CHLOROCHYTRIUM*

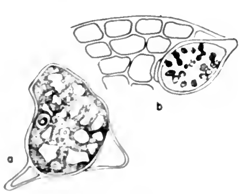

Figure 94

Fig. 94. *Chlorochytrium Lemnae* Cohn. a, showing net-like chloroplast (redrawn from Bristol-Roach); b, cell in host tisue.

The duckweed, *Lemna trisulca*, is the most common host for this endophytic alga. Old plants of *Lemna* as they become colorless in age, usually reveal minute green spots caused by *Chlorochytrium*.

There are probably three other species in the United States, differentiated by cell size and thickness of the wall which is usually much lamellated.

121a (117) Cells attached, either sessile or on a stalk.............122

121b Cells free-floating or forming a film on moist earth..........126

122a Cells bearing a seta or hair..............................123

122b Cells without setae....................................124

123a Setae simple (unbranched). See Fig. 62..*CHAETOSPHAERIDIUM*

123b Setae branched. See Fig. 61................*DICRANOCHAETE*

124a Cells on a slender stalk or with the basal portions of the cell narrowed to form a stalk....................................125

124b Cells globular, attached by a broad, short stalk. Fig. 95...... ....*MALLEOCHLORIS*

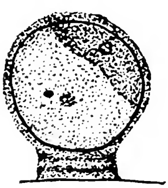

Figure 95

Fig. 95. *Malleochloris sessilis* Pascher (redrawn from Pascher).

This rare plant is to be sought on filamentous algae such as members of the Cladophoraceae. The sheath that incloses the cell is often reddish. Reproduction (similar to other Tetrasporales) is by swimming spores and by isogametes.

125a Cells globular, with chloroplast lying along the outer free wall; growing on *Anabaena* or *Coelosphaerium*. Fig. 96............. ....*STYLOSPHAERIDIUM*

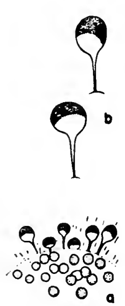

Figure 96

Fig. 96. *Stylosphaeridium stipitatum* (Bach.) Geit. & Gimesi, a, habit of cells in colonial mucilage of *Coelosphaerium;* b, single cells showing apical position of chloroplast.

This curious epiphyte is found in abundance when it occurs at all as minute "hat pins" in the mucilage of colonial blue-green algae such as *Coelosphaerium*. (Fig. 319.)

125b Cells elongate-ovoid, or fusiform, or if globular, with a chloroplast parietal along the lateral walls. See Fig. 87. . *CHARACIUM* (Compare with *Characiopsis*, Fig. 217, a genus similar in shape, belonging to the Chrysophyta in which the chromatophores are yellowish-green.)

126a (121) Cells elongate-fusiform, or rod-shaped, crescent-shaped, slightly curved, or straight; several to many times longer than their diameter 127

126b Cells oval, circular (or nearly so), pyramidal, trapezoidal, or star-shaped, isodiametrically angular; not more than 3 times the diameter in length 146

127a Cells with narrowed apices, sometimes sharply pointed . . . 128

127b Cells with broadly rounded or truncate apices 133

128a Chloroplasts 2, axial, one in either horn of a crescent-shaped cell which may be only slightly curved. See Fig. 86. . . . *CLOSTERIUM*

128b Chloroplasts otherwise 129

129a Cells decidedly fusiform, one or both poles extended into setae or sharp points 130

129b Cells not broadly fusiform 132

130a Cells actually globular but inclosed in a fusiform sheath with longitudinal ridges. Fig. 97 . . . . *DESMATRACTUM*

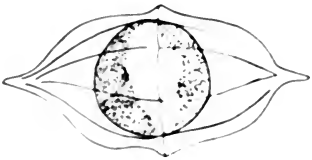
Figure 97

Fig. 97. *Desmatractum bipyramidatum* (Chod.) Pascher.

This unique species, the only one of the genus in this country, is rather rare but seems to be widely distributed in the plankton of both streams and lakes. The wall is very wide and transparent, forming a sheath-like envelope.

130b Cells themselves fusiform; without such a sheath............131

131a Setae formed by a narrowing of the cell to a fine point; chloroplast laminate (plate-like), not extending the full length of the cell. See Fig. 89..................................*OUROCOCCUS*

131b Setae formed by a fine spine on the wall, extending from the narrowed tips of the cells. See Fig. 88...........*SCHROEDERIA*

132a (129) Cells many (20 or more) times longer than wide; the chloroplast with a row of pyrenoids. Fig. 98.........*CLOSTERIOPSIS*

Figure 98

Fig. 98. *Closteriopsis longissima* Lemm.

There is but one species reported from this country. Although it superficially resembles a *Closterium* (Fig. 86) it is easily separated on the basis of the single, plate-like chloroplast which may be notched or crenulate along the margin. At times the cells are slightly curved but usually are more nearly straight than any of the species of *Closterium*.

132b Cells less than 20 times the diameter long; slender needles or narrowly fusiform cells with one pyrenoid sometimes evident. See Fig. 68..............................*ANKISTRODESMUS*

133a (127) With a notch in the ends of the cell. Fig. 99..*TETMEMORUS*

Figure 99

Fig. 99. *Tetmemorus laevis* (Kuetz.) Ralfs.

This is a genus belonging to the true desmids, having a wall in 2 pieces that adjoin in the midregion. Species that are found in this country seem to be confined to highly acid situations. There are several species reported, some with cylindrical shapes and some with the ends tapering, but always with a prominent polar notch. A placoderm desmid.

133b Without a notch in the ends of the cell 134

134a Cells crescent-shaped, with an axial chloroplast bearing ridges in each horn. See Fig. 86 . . . . *CLOSTERIUM*

134b Cells not crescent-shaped, or with other types of chloroplasts . . 135

135a Cells constricted in the midregion to form 2 'semicells' which are mirror images of one another 136

135b Cells not constricted in the midregion to form 'semicells' 141

136a Cells furnished with whorls of protuberances which bear one or two spines; poles of the cell forked. Fig. 100 . . . . . *TRIPLOCERAS*

Figure 100

Fig. 100. *Triploceras gracile* Bailey.

There are apparently only two species of this desmid genus in the United States, easily identified by the whorls of spine-bearing protuberances along the walls. Like a number of other desmid genera this one seems to be confined to acid water, especially in *Sphagnum* bogs.

136b Cells not furnished with whorls of spiny protuberances 137

137a Cells 10 or more times longer than broad, usually cylindrical or nearly so, with margins smooth or undulate 138

137b Cells less than 10 times their diameter in length; cylindric, fusiform, or tumid, usually straight but sometimes slightly curved . . 139

138a With a circle of folds or creases at the base of the 'semicell,' with a tooth on each fold. Fig. 101 .... *DOCIDIUM*

Figure 101

Fig. 101. *Docidium undulatum* Bailey.

This genus is scarcely to be separated from *Pleurotaenium* (Fig. 102). In cells that are living the density of the chloroplast makes obscure the characteristic creases in the wall where the two semicells are adjoined. One needs to focus carefully to see these folds which produce teeth-like projections at the very outer margin of the bases of the semicell, especially in individuals which have a granule on the fold. Another species, *D. Baculum* Breb., less common than the species illustrated, has smooth lateral walls.

138b Without a circle of creases at the base of the 'semicell.' Fig. 102. .... *PLEUROTAENIUM*

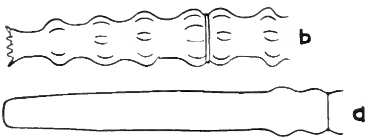

Figure 102

Fig. 102. a, *Pleurotaenium trabecula* (Ehr.) Naegeli; b, *P. nodosum* Bailey.

There are more species in this genus than in *Docidium* (Fig. 101) and they are more widely distributed. Although all of them are elongate and usually have subparallel margins, there is considerable variation in details of the shape and in decoration of the wall. In some species the margins are nodose or undulate; some spiny. Usually there is a circle of granules around the poles of the cell. Some species are not so restricted in their distribution as most desmids, and may occur in basic or slightly alkaline waters as well as in acid or soft water habitats.

139a Cells with 2 star-shaped chloroplasts, one in each 'semicell.' Fig. 103 .... *CYLINDROCYSTIS*

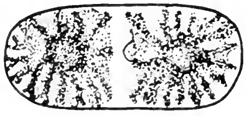

Figure 103

Fig. 103. *Cylindrocystis Brebissonii* Menegh.

Although some of the half-dozen species of this genus have slightly constricted cells, they have a wall composed of one piece and have no wall pores, which thus identifies them as saccoderm (not true) desmids. There is one star-shaped chloroplast with a large pyrenoid in each half of the cell. This genus is not at all confined to acid habitats; may occur in alkaline bogs or among mosses, or may form gelatinous masses on wet stones in alpine situations.

139b Cell with other types of chloroplasts 140

140a Cells short-cylindric, or subcylindrical; chloroplasts 1 in each 'semcell' (rarely 3 or 4 chloroplasts forming transverse zones in the cell); no vacuoles with moving granules in the poles of the cell. Fig. 104 .... *PENIUM*

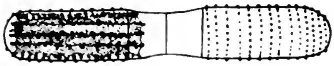

Figure 104

Fig. 104. *Penium margaritaceum (Ehr.)* Breb.

Some species of this genus are shaped like those of *Cylindrocystis* (Fig. 103) but have a wall of two pieces that adjoin in the midregion, and the wall usually shows punctations or granulations. In general, *Penium* cells are more cylindrical than *Cylindrocystis* and because new wall sections are built in when the cells divide, they may become as long as some small *Pleurotaenium* (Fig. 102).

140b Cells slightly attenuated at the apices; chloroplasts with several pyrenoids; vacuoles with moving granules in the poles of the cell. See Fig. 86 .... *CLOSTERIUM*

141a (135) Chloroplasts spiral ribbons 142

141b Chloroplasts some other shape 143

142a Cells "cigar"-shaped, poles rounded. Fig. 105 .... *SPIROTAENIA*

Figure 105

Fig. 105. *Spirotaenia condensata* Breb.

This "cigar"-shaped cell is usually straight but may be slightly curved. Although one species in the United States has an axial chloroplast, the others have a characteristic spirally twisted one in each cell. The cell is never constricted in the midregion and the wall is composed of 1 piece as in other saccoderm desmids.

142b Cells cylindrical with truncate ends. Fig. 106 .... *GENICULARIA*

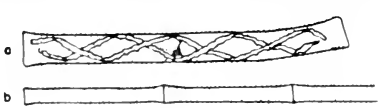

Figure 106

Fig. 106. *Genicularia elegans* West. a, Single cell; b, filamentous arrangement.

The cells may be solitary or occur in filaments. Although the chloroplasts are spirally twisted and show a superficial resemblance to *Spirogya* (Fig. 147) this genus is usually identifiable by the cells being slightly enlarged at the poles. *Genicularia* is classified in the Gonatozygonaceae but is closely related to the desmids and is found associated with them in nature.

143a (141) Cells cylindrical, 10 or more times the diameter in length, the poles truncate; wall spiny. Fig. 107........*GONATOZYGON*

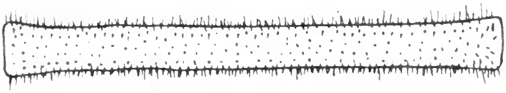

Figure 107

Fig. 107. *Gonatozygon aculeatum* Hastings.

This desmid-like genus has solitary cells which are nearly always a little crooked; have walls bearing long or short spines; are not constricted at the midregion. Although usually free-floating and intermingled with desmids, the cells may be adherent to submerged plants. There is a ribbon-like chloroplast that is axial rather than parietal. As mentioned above, *Gonatozygon* may be classified with *Genicularia* to form the Gonatozygonaceae by some authorities, whereas others place it with the saccoderm desmids in the family Mesotaeniaceae.

143b Cells fusiform short-cylindric, less than 10 times the diameter in length; wall smooth....................................144

144a Cells broadly fusiform or subcylindrical; 2 chloroplasts, one in each end of the cell, bearing longitudinal ridges, usually with notched margins. Fig. 108..........................*NETRIUM*

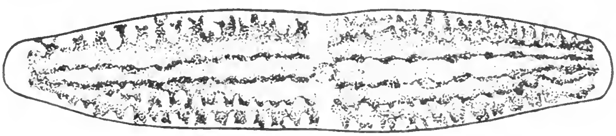

Figure 108

Fig. 108. *Netrium digitus* (Ehr.) Its. & Rothe.

These are "watermelon"- or "cucumber"-shaped cells which are saccoderm desmids with scarcely any or no constriction in the midregion. Like other members of the family the cell contents are conspicuously symmetrically divided into two portions, there being 1 (rarely more) longitudinally ridged chloroplasts in each half of the cell. There are 5 or 6 species in this country, differentiated by shape and proportions of the cell.

144b Cells cylindrical or narrowly fusiform, with 1 chloroplast in the cell..145

145a Cells "cigar"-shaped; chloroplast axial with 4-6 pyrenoids. Fig. 109..*ROYA*

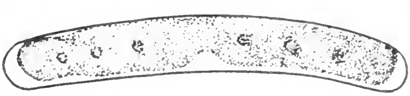

Figure 109

Fig. 109. *Roya obtusa* (Breb.) West & West.

This rather rare saccoderm desmid has slightly curved cylindrical cells in which there is but a single chloroplast that is notched in the midregion where the nucleus is located.

145b Cells elongate-ellipsoid or ovoid to subcylindrical; 1 parietal chloroplast; cell contents violet-colored. See Fig. 46..*MESOTAENIUM*

146a (126) Cells constricted in the midregion....................147

146b Cells not constricted in the midregion....................154

147a Cells flat, nearly circular in proportions, star-like in front view, the median incision very deep; semicells deeply lobed or incised, in some species forming secondary lobes and lobules. Fig. 110 ....*MICRASTERIAS*

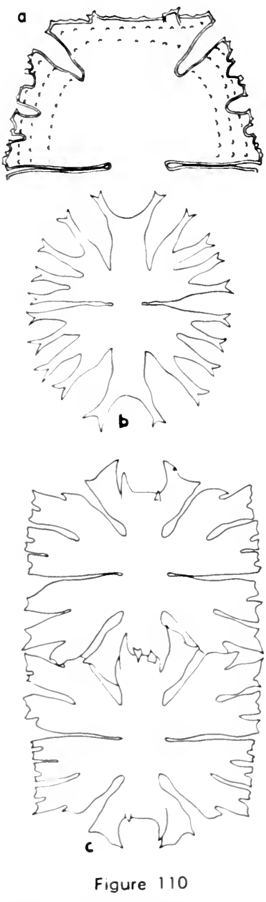

Figure 110

Fig. 110. a, *Micrasterias americana* var.; *Boldtii* Gutw.; b, *M. radiata* Hass. var.; c, *M. foliacea* Bailey.

These are true desmids and include some of the most beautiful microscopic objects. Although the outline of the cell varies greatly among the twenty or more species in this country, they can be identified by the flat, disc-like shape. One species, *M. foliacea* Bailey, has hooks on the polar lobes which enmesh with those of adjoining, newly-formed cells so that false "filaments" are produced.

147b Cells not flat and disc-like....................148

148a Cells with a shallow and broad, or a deep and narrow notch in the apex of the semicell. Fig. 111 . . . . *EUASTRUM*

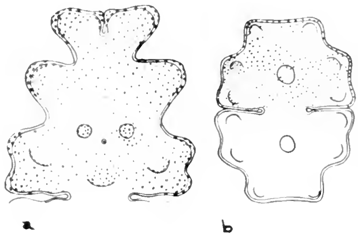

Figure 111

Fig. 111. a, *Euastrum pinnatum* Ralfs; b, *E. pectinatum* var. *inevolutum* West & West.

There are numerous species in this desmid genus, varying greatly in size and shape of cell. Most of them, however, have a polar notch in the semicells and, characteristic of the genus, have more or less prominent protrusions and swellings on the face of the semicell. In filled cells the latter are difficult of determination, especially in the smaller species. The specimens need to be rolled so that they can be seen from the side or top when making microscopic examinations. Nearly all of the species of *Euastrum* are limited to an acid habitat.

148b Cells without a notch in the apex of the semicell 149

149a Apex of the cell extended into 2 or more arms or lobes, the arms usually extending radiately so that the cells are star-shaped or triangular when seen from the top (end view). Fig. 112 . . . . *STAURASTRUM*

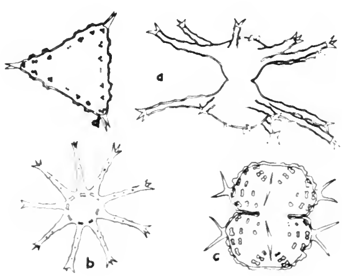

Figure 112

Fig. 112. a, *Staurastrum rotula* Nordst., 'front' or side view; b, end view; c, *St. cornutum* Arch.; d, end view.

This is a large desmid genus with several hundred species which vary in shape of semicell and type of decoration on the wall. The chief distinguishing characteristic is the extension of lobes or arms in at least 3 planes so that the cell appears radiate when seen from the top. Many species appear like *Cosmarium* (Fig. 113) when seen in front view and one needs to change the plane of focus in order to see the semicell extending up toward the observer, or down as the case may be. A few species have arms in 1 plane only and these are retained in the genus by virtue of the fact that the shape and decorations of the arms (spines, verrucae, etc.) are those of *Staurastrum*. Some species are definitely euplanktonic and have long arms which give them buoyancy, whereas others are tychoplanktonic and are intermingled with other desmids in acid swamps.

149b Apex of semicell not extended into arms, or if with arms these not radiating in 3 planes 150

150a Semicells with 2 extended arms at their apices as seen in front view, narrowly elliptic when seen from the top. See Fig. 112½. .... *STAURASTRUM*

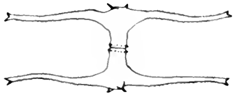

Fig. 112½. Staurastrum leptocladum Nordst.

150b Semicells compressed or rounded when seen from the top or side, not with radiating arms................................151

151a Margin of cell furnished with spines........................152

151b Margin of cell without spines, although sometimes granular. Fig. 113 .... *COSMARIUM*

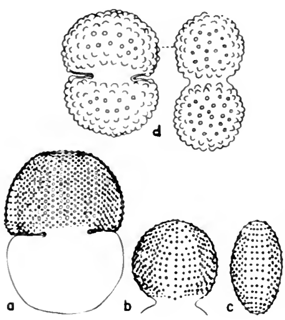

Figure 113

Fig. 113. a-c, *Comarium panamense* Presc.; b, side view; c, top view; d, *C. margaritatum* (Lund.) Roy & Biss., front and side view.

Like the genus *Staurastrum* (Fig. 112) *Cosmarium* includes several hundred species with considerable variation in shape of semicell and manner of wall decoration (granules, teeth, scrobiculations). Nearly all are compressed or rounded when seen from the side or top, regardless of their shape when seen from the front or broad side.

152a Face of semicell with protuberances or with the wall thickened in the midregion (best seen when the cell is rolled to a lateral view position) 153

152b Face of semicell without swellings or protuberances. Fig. 114. .... *ARTHRODESMUS*

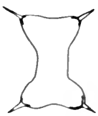

Figure 114

Fig. 114. *Arthrodesmus incus* (Breb.) Hass.

This genus has compressed cells like *Cosmarium* but the angles bear relatively stout spines. The wall is smooth in this genus, there being no granules, pits or swellings.

153a Apex of semicell furnished with prominent spines; facial protuberance (if any) one large low swelling, the wall thickened here and often pitted or punctate. Fig. 115 . . . . *XANTHIDIUM*

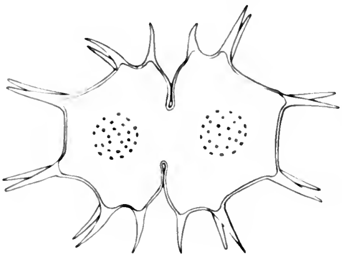

Figure 115

Fig. 115. *Xanthidium cristatum* var. *uncinatum* Hass.

This genus too, like *Arthrodesmus* (Fig. 114) has cells that are compressed so that they are narrow when seen from the side or top. There is usually a facial swelling in the center of the semicell and all angles bear stout spines or short arms that are tipped with spines. Some forms have granules on the wall. There is less variation in the shape of the semicell in this genus than in some of the other desmids.

153b Apex without spines or with a short, tooth-like spine at either side. See Fig. 111 . . . . *EUASTRUM*

154a (146) Cells spherical, inclosed by a spindle-shaped envelop which has longitudinal ridges. See Fig. 97 . . . . *DESMATRACTUM*

154b Cells not inclosed in such an envelope 155

155a Cells oval, ovoid, spherical or ellipsoid 156

155b Cells angular, pyramidal, trapeziform, or polygonal 183

156a Cells subcylindrical or ovoid, small, less than 4.5 μ in diameter, with a parietal plate-like chloroplast at one or both ends. Fig. 116 .... *NANNOCHLORIS*

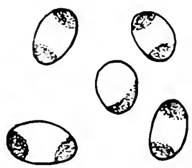

Figure 116

Fig. 116. *Nannochloris bacillaris* Naum.

These tiny cells are solitary and are without a gelantinous sheath. They are able to undergo cell division in vegetative reproduction and hence are assignable to the Coccomyxaceae along with *Elakatothrix* (Fig. 38) and *Dactylothece* (Fig. 47). It is a frequenter of laboratory culture.

156b Cells different in size and shape, or with a different type of chloroplast 157

157a Cells bearing spines or decorated with ridges 158

157b Cells without spines or decorations 164

158a Spine length greater than the diameter of the cell 159

158b Spine length less than the diameter of the cell; wall usually decorated with a network of thickenings 163

159a Spines not tapering from base to apex, long and slender 161

159b Spines tapering to apex, long and slender, or short and stout . . 160

160a Spines stout, broad at the base and tapering. Fig. 117 .... *ECHINOSPHAERELLA*

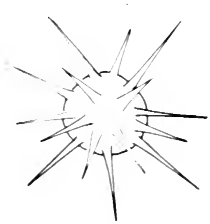

Figure 117

Fig. 117. *Echinosphaerella limnetica* G. M. Smith.

This is a relatively rare species from the euplankton. In making identification care should be used in distinguishing the single parietal chloroplast by which the plant may be differentiated from some of the spiny zygospores of desmids (in which the cell content appears dark and massive, with no definitely shaped chloroplast distinguishable).

160b Spines long and slender, gradually tapering in the basal part for a short distance, and then abruptly narrowed to a needle. Fig. 117½ ....*ACANTHOSPHAERA*

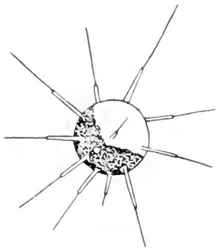

Figure 117½

Fig. 117½. *Acanthosphaera Zachariasi* Lemm.

This plant can be distinguished from *Echinosphaerella* (Fig. 117) because the spines are long and somewhat needle-like, arising from a base which is decidedly thicker than in the outer section.

161a (159) Cells round. See Fig. 84....................*GOLENKINIA*

161b Cells oval or ellipsoid.......................................162

162a Spines at the poles or at the equator of the cell. Fig. 118....... ....*LAGERHEIMIA (CHODATELLA)*

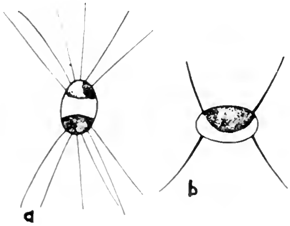

Figure 118

Fig. 118. a, *Lagerheimia longiseta* (Lemm.) Printz; b, *L. quadriseta* (Lemm.) G. M. Smith.

Unlike *Franceia* (Fig. 73) cells of this genus have long, needle-like spines confined to the poles or to the poles and the equator. There are 3 or 4 species reported from this country which are differentiated on the basis of cell shape and arrangement of spines. All are fairly common in the euplankton.

162b Spines distributed over the cell wall. See Fig. 73....*FRANCEIA*

163a (158) Cells round. Fig. 119 .... *TROCHISCIA*

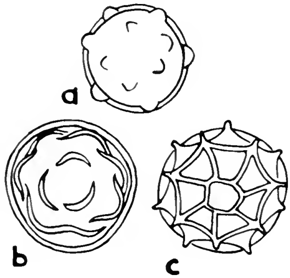

Figure 119

Fig. 119. a, *Trochiscia granulata* (Reinsch) Hansg.; b, *T. obtusa* (Reinsch) Hansg.; c, *T. reticularis* (Reinsch) Hansg.

There are 5 or 6 species of this genus, all solitary cells, which may be differentiated by the type of wall decoration. It is a little-understood genus and some of the described species are doubtless the zygospores of other algae. Some may be the encysted or resting stages of still other forms. In making identification of plants with the outward characteristics of *Trochiscia* care should be used in identifying the several disc-like chloroplasts which this genus possesses.

163b Cells oval. Fig. 120 .... *BOHLINIA*

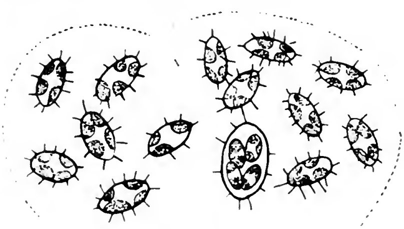

Figure 120

Fig. 120. *Bohlinia echidna* (Bohlin) Lemm.

This rather unique species (the only one in the genus) appears in amorphous gelatinous masses. Reproduction is by internal cell division to form autospores. Although older cells are characteristically spiny recently formed individuals may be smooth-walled. The observer should examine the plant mass for remains of the old cell walls which will show evidence of the spinescence.

164a (157) Cells associated with fungi to form thalli of lichens. Fig. 121 .... *TREBOUXIA*

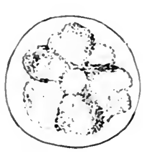

Figure 121

Fig. 121. *Trebouxia Cladoniae* (Chod.) G. M. Smith.

This species is an inhabitor of lichens and apparently occurs nowhere else. The cells are spherical and contain an axial rather than a parietal chloroplast like most of the other members of the Chlorococcales.

164b Cells not associated with fungi in lichens 165

165a Chloroplast 1, central, with radiating lobes extending to the wall 166

165b Chloroplast not axial, or more than 1 in a cell, without radiating arms 167

166a Chloroplast definitely star-shaped with a central pyrenoid; cells spherical. See Fig. 51 .... *ASTEROCOCCUS*

166b Chloroplast irregularly lobed, not symmetrically radiate, without a pyrenoid; cells pyriform. Fig. 122 .... *MYRMECIA*

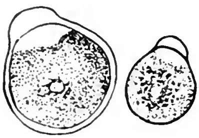

Figure 122

Fig. 122. *Myrmecia aquatica* G. M. Smith (redrawn from Smith).

These cells are either spherical or somewhat pear-shaped and usually show a thickening of the wall at one side, giving them an unsymmetrical shape. Although the genus was originally described from aerial situations, specimens in this country have been collected from aquatic habitats.

167a (165) Cells spherical 168

167b Cells oval or ellipsoid 174

168a Cells large, wall thin; chloroplast irregular in shape and lumpy with starch grains, arranged in radiating strands from the center of the cell, and also parietal. Fig. 123 .... *EREMOSPHAERA*

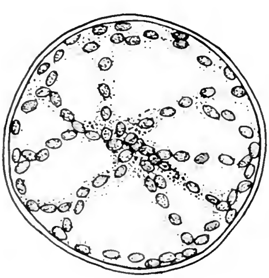

Figure 123

Fig. 123. *Eremosphaera viridis* De Bary.

This is one of the largest spherical cells (up to 800 microns in diameter) encountered among the unicellular algae. Although usually solitary it may appear in clusters within the old mother-cell wall. There is one other rare species (with oblate-spheroidal cells) but the plant illustrated is fairly common in habitats where desmids abound. The numerous disc-like chloroplasts are often lumpy and irregular in shape because of the starch grains which collect about them.

168b Cells not as above 169

169a Cells enclosed by a mucilaginous sheath....................170

169b Cells not enclosed by a sheath..........................171

170a Cells eccentrically placed in a sheath which has numerous lamellations (layers); pyrenoid lacking. Fig. 124......*UROCOCCUS*

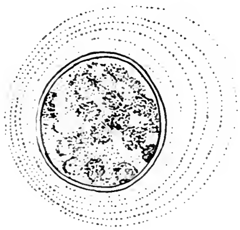

Figure 124

Fig. 124. *Urococcus insignis* (Hass.) Kuetz.

Although holding a place in the Tetrasporales according to its assignment in the past, this reddish-colored cell has been shown to be an encysted stage of one of the motile Dinoflagellates (Pyrrhophyta). Unless other species are shown to be separable and distinctive, the genus may be reduced to synonymy.

170b Cells centrally placed in a sheath which has few or no lamellations; pyrenoid present; (usually colonial, sometimes solitary). See Fig. 41 ....*GLOEOCYSTIS*

171a (169) Chloroplast 1; cells solitary (often gregarious)..........172

171b Chloroplasts more than 1; (cells usually ellipsoid in a gregarious association but sometimes round). Fig. 125..*PALMELLOCOCCUS*

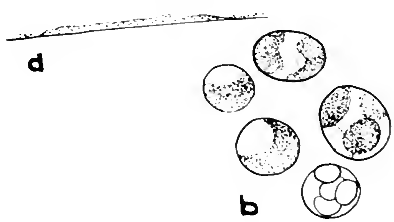

Figure 125

Fig. 125. *Palmellococcus miniatus* (Kuetz.) Chod. a, habit of colony; b, portion of colony showing cells with *Chlamydomonas*-like chloroplast.

These oval or spherical cells usually occur as films on moist substrates (rocks, cement walls, etc.). There are 1 to several chloroplasts without pyrenoids. Reproduction is by the formation of autospores (Chlorococcales). Identification is difficult unless the organisms are cultured because there are so many minute green cells which might be confused with this genus.

172a Cells associated to form an extended stratum on trees, wood, stones. See Fig. 66.........*PROTOCOCCUS (PLEUROCOCCUS)*

172b Cells not forming such a stratum.........................173

173a Chloroplast a thin layer along the wall; pyrenoid usually lacking; free-living or in tissues of animals (sponges, etc.), reproducing by autospores (replicas of the adult cell). See Fig. 91...... ....*CHLORELLA (ZOOCHLORELLA)*

173b Chloroplast a massive cup with a pyrenoid; on damp aerial substrates; reproducing by zoospores. See Fig. 42................ ....*CHLOROCOCCUM*

174a (167) Cells oval, ovate, or irregular globose, with thick-layered walls bearing knobs and protrusions........................175

174b Cells without thick walls and knob-like protrusions..........176

175a Chloroplasts numerous, parietal, cone-shaped. Fig. 126......... ....*EXCENTROSPHAERA*

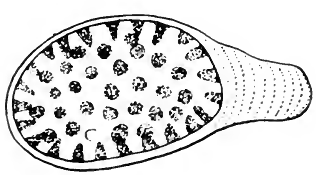

Figure 126

Fig. 126. *Excentrosphaera viridis* G. T. Moore.

This is the only species reported for the genus. It is found in the water or in very wet soil and is identified by its irregular shape produced by a lamellated thickening of the wall in one or more places. The chloroplasts are cone-shaped and all are directed inwardly from their parietal position along the wall.

175b Chloroplast a massive, axial body with processes which are flattened against the wall. Fig. 126½ . . . . *KENTROSPHAERA*

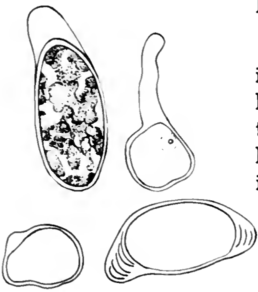

Figure 126½

Fig. 126½. *Kentrosphaera Bristolae* G. M. Smith.

There are 2 or 3 species of this genus (often included in the genus *Chlorochytrium* (Fig. 94) but only *K. Bristolae* has been reported from this country. The cells are similar in shape but have a free-living habit, usually occurring in damp soil.

176a (174) Cells with spines 177

176b Cells without spines 179

177a Spines distributed over the cell wall 178

177b Spines localized at the poles or at the midregion of the cell. See Fig. 118 . . . . *LAGERHEIMIA (CHODATELLA)*

178a Spines shorter than the diameter of the cell. See Fig. 120 . . . . *BOHLINIA*

178b Spines needle-like, as long as or longer than the diameter of the cell; cell solitary or in 2's. See Fig. 73 . . . . *FRANCEIA*

179a (176) Cells with spiral, longitudinal ribs on the walls. Fig. 127. . . . . *SCOTIELLA*

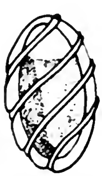

Figure 127

Fig. 127. *Scotiella nivalis* (Chod.) Fritsch.

This genus contains a number of species, most of which have been collected in the flora of red snow at high altitudes. Differences lie in the shape of the cell and the type of ridged decorations on the wall. Occasionally *Scotiella* species are collected in the tychoplankton at low altitudes. Some authorities place this genus in the Volvocales because of the type of chloroplast and the evidence of basal-distal differentiation in the cell; whereas others include it with the Chlorococcales.

179b Cells without longitudinal ribs............................180

180a Cells small, less than 4.5 μ long, with a plate-like chloroplast at one end. See Fig. 116.......................*NANNOCHLORIS*

180b Cells relatively large, without such a chloroplast............181

181a Two or more masses of dark mucilage appearing at either end or on either side of the cell; usually 2-4 cells in a common investment, but often solitary. See Fig. 83..........*GLOEOTAENIUM*

181b Without dark masses of mucilage about the cells.............182

182a Cells oval, often solitary but usually gregarious, forming an expanse on moist aerial substrates. See Fig. 125................ ....*PALMELLOCOCCUS*

182b Cells lemon-shaped oval or ellipsoid (usually several together in old mother-cell wall, but may occur solitary); aquatic. See Fig. 85 ....*OOCYSTIS*

183a (155) Cell body actually spherical but with 4 long, narrow, brown arm-like appendages radiating from it. Fig. 128..*PACHYCLADON*

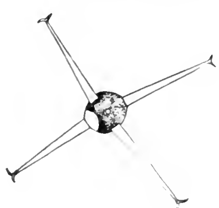

Figure 128

Fig. 128. *Pachycladon umbrinus* G. M. Smith. (Redrawn from Smith.)

This rare plant (one species in the genus) occurs in the euplankton of lakes. The long, darkly colored appendanges from a relatively small, subspherical cell body make it easy of identification.

183b Cell shaped differently, or not with such appendages.......184

184a With several long spines forming a tuft at the angles of the cell. (See *Polyedriopsis quadrispina,* however) at the angle of the cell. Fig. 129 ....***POLYEDRIOPSIS***

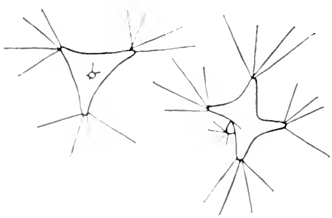

Figure 129

Fig. 129. *Polyedriopsis spinulosa* G. M. Smith.

There are 2 species in this genus, both of which are euplanktonic. They are rectangular or polyhedral in shape with from 1 to 4 long spines at each angle. *P. quadrispina* G. M. Smith has but 1 stout spine at each angle; is quadrate in shape.

184b With 1, 2, or 3 spines, or without spines at the angles of the cell 185

185a Without spines 186

185b With 1-3 spines at the angles...........................187

186a Body of the cell gradually narrowed at the angles to form horn-like, twisted processes. Fig. 130.................***CERASTERIAS***

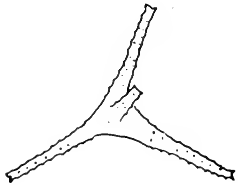

Figure 130

Fig. 130. *Cerasterias irregulare* G. M. Smith.

There is apparently only 1 good species in this genus which is characterized by having irregularly triangular cells with twisted processes. Occurs in the euplankton. Should be compared with *Tetraedron* (Fig. 131).

186b Body of the cell abruptly narrowed to form horn-like processes. Fig. 131 .... *TETRAEDRON*

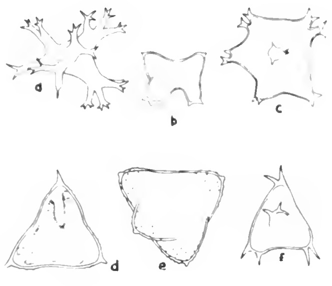

Figure 131

Fig. 131. a, *Tetraedron limneticum* Borge; b, *T. asymmetricum* Presc.; c, *T. lobulatum* var. *crassum* Presc.; d, *T. regulare* var. *granulatum* showing chloroplast; e, *T. regulare* var. *granulatum* Presc.; f, *T. regulare* var. *bifurcatum* Wille.

This genus contains a large number of species which vary considerably in their shape and in the number of arms or processes. Whereas some are simple and have rounded angles, others are polyhedral in shape and have varying degrees of lobings at the angles. They occur both in the euplankton and in the tychoplankton.

187a (185) Cells with 1 spine at each angle 188

187b Cells with 2 or 3 spines at the angles. Fig. 131b ... *TETRAEDRON*

188a Spines slender and needle-like. See Fig. 129 ... *POLYEDRIOPSIS*

188b Spines broader at the base and stout, decidedly tapering. Fig. 132 .... *TREUBARIA*

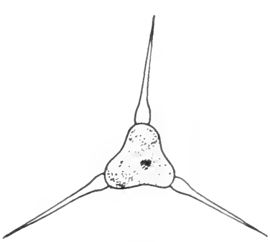

Figure 132

Fig. 132. *Treubaria crassispina* G. M. Smith.

This free-floating plant is similar to *Pachycladon* (Fig. 128) but the processes are not darkly colored and are not toothed at the tip.

189a (35) Plant a microscopic unbranched filament, attached or free-floating: or a macroscopic thallus in the form of an expanded sheet, a tube, or an arbuscular (tree-like) gelatinous and beaded growth 190

189b Plant a branched filament, a coenocytic tube (without cross walls) or an attached cushion or disc in which the branching habit is obscure because of closely appressed branches..............241

190a Cells constricted in the midregion, with 2 large chloroplasts, one in either 'semicell'....................................191
(In some species of filamentous desmids the constriction is very slight, being only a slight invagination or concavity of the lateral walls. See illustrations of *Hyalotheca*, Fig. 137, and of *Gymnozyga*, Fig. 136 before proceding in the key.)

190b Cells not constricted in the midregion.......................198

191a Cells adjoined by the interlocking of short, straight, horn-like or hooked processes at the poles.............................192

191b Cells adjoined by their end walls, either along the entire apical surface, or at the ends of arms which project from the apex..194

192a Interlocking polar processes simple, slender and horn-like. Fig. 133 .... *ONYCHONEMA*

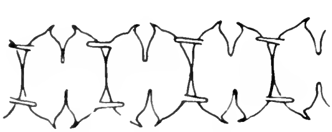

Figure 133

Fig. 133. *Onychonema laeve* var. *latum* West & West.

There are 2 rather common species of this filamentous desmid genus. *O. filiforme* (Ehr.) Roy & Biss. has the lateral angles of the semicells furnished with a spine and the polar processes are relatively long. *O. laeve* Nordst. has cells without lateral spines and appears like a small *Cosmarium* (Fig. 113) in a filament, the cells adjoined by short (sometimes scarcely evident) polar processes.

192b Interlocking polar processes not slender and horn-like......193

193a Interlocking processes in the form of forked lobes which bear recurved hooks. See Fig. 110................*MICRASTERIAS*

193b Interlocking processes simple, short and tuberculate. Fig. 134. ....*SPHAEROZOSMA*

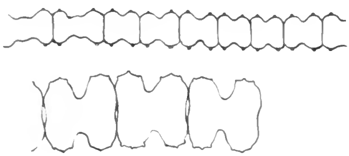

Figure 134

Fig. 134. *Sphaerozosma excavata* Ralfs.

This is a filamentous desmid in which the cells are adjoined by the interlocking of the polar processes themselves. None of the species bear spines but they usually have minute granules at the angles of the semicell, or forming transverse bands across the semicell. This genus usually occurs in acid lakes, intemingled with other desmids.

194a (191) Semicells transversely elliptic or oval, the median incision of the cell deep. Fig. 135....................*SPONDYLOSIUM*

Figure 135

Fig. 135. *Spondylosium* sp.

Although this genus can have cells that are triangular in end view, most species have cells that are compressed and are somewhat like *Cosmarium* (Fig. 113) in a filament. One species which is rather rare is *S. pulchrum* (Bail.) Archer. It has semicells which are much extended laterally so that the cell is much wider than long. The apices of the cells in this are furnished with a protrusion which adjoins that of the adjacent cells in the filament. The walls are smooth and undecorated.

194b Semicells not transversely elliptic, median incision not deep, sometimes only a slight concavity of the lateral wall.......195

195a Cells cylindrical, subcylindrical, or barrel-shaped...........196

195b Cells quadrate or angular, usually with the margins conspicuously lobed. (See Fig. 138b, *Desmidium Baileyi*, however)......197

196a Cells barrel-shaped, with a slight notch-like median incision in the broadest part of the cell where it is somewhat bulged. Fig. 136 .... *GYMNOZYGA*

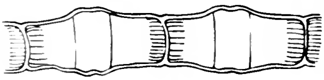

Figure 136

Fig. 136. *Gymnozyga moniliformis* Ehr.

There are 3 species of this genus found in the United States, differentiated mostly on the size and proportions of the cell, but none are as common as the one illustrated. This species occurs sometimes almost pure in pools within *Sphagnum* bogs, and is a common component of the desmid flora of almost any soft or acid water habitat. *G. moniliformis* is characterized by having barrel-shaped cells that have longitudinal striations in the apical portion of the semicells. These are sometimes faintly seen, especially in living cells when the chloroplast obscures them.

196b Cells cylindrical or somewhat rectangular, with a broad and shallow emargination rather than an incision in the midregion. Fig. 137 .... *HYALOTHECA*

(See also *Desmidium Baileyi*, Fig. 138b.)

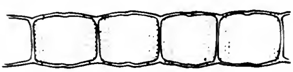

Figure 137

Fig. 137. *Hyalotheca dissiliens* (Smith) Breb.

There are 3 or 4 common species of this genus, differentiated by cell shape and proportion, some being short and nearly quadrate whereas others are cylindrical. In some individuals the constriction of the cell occurs only as a shallow invagination in the median part. In *Sphagnum* bogs small pockets of water or pools in the mat may be densely green with a pure growth of *H. mucosa* (Dill.) Ehr., a species which has a conspicuous gelatinous sheath.

197a Cells wider than long or as wide as long, without a median incision or with but a slight median notch; walls at the poles of young semicells infolded or replicate . Fig. 138..... *DESMIDIUM*

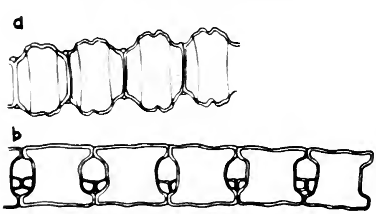

Figure 138

Fig. 138. a, *Desmidium Grevillii* (Kuetz.) De Bary; b, *D. Baileyi* (Ralfs) Nordst.

Cells of this filamentous desmid genus vary much in shape. Some are oval and moniliform when seen in end view, some are triangular, and some are quadrangular. The shape of the cell may be determined by careful focusing up and down through the depth of a specimen. A characteristic habit of some species is to show a spiral twisting of the cell arrangement so that in any one view they do not have their processes in the same plane throughout the length of the filament. *Desmidium* usually occurs in the same habitats with *Hyalotheca* (Fig. 137).

197b Cells a little longer than wide, rectangular, with a narrow median incision; 4-lobed in end view; poles of young cells infolded. Fig. 139. .... *PHYMATODOCIS*

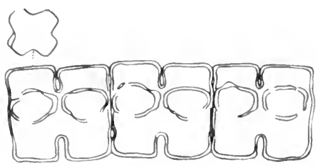

Figure 139

Fig. 139. *Phymatodocis Nordstedtiana* Wolle.

Although rarely found this filamentous desmid may be the dominant form in some habitats that are especially favorable. The cells appear somewhat quadrangular when seen in front view (as they occur in the filament) but are quadrilaterally symmetrical and are 4-lobed as seen in end view.

198a (190) Chloroplast parietal, of various shapes, net-like, ring-like, or plate-like, with pads and thin areas (Fig. 139¼); or if axial, plants in the form of a macroscopic thallus as in Fig. 153 210

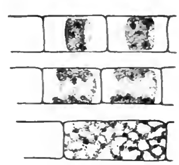

Figure 139¼

198b Chloroplast axial, a broad band, or star-shaped; if parietal, in the form of a ribbon as in Fig. 139½; microscopic.......... 199

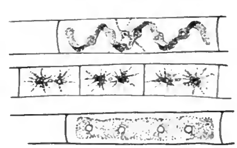

Figure 139½

(The following genera are determined with difficulty when in the vegetative condition alone; reproductive structures and 'fruiting' stages are often necessary for completely satisfactory identification.)

199a Chloroplast 1 or 2 in a cell; stellate, with radiating processes from a central core which includes a pyrenoid.................. 200

199b Chloroplasts other shapes.................................. 203

200a Cells quadrate, with 1 star-shaped chloroplast containing a single pyrenoid. Fig. 140 .... *SCHIZOGONIUM*

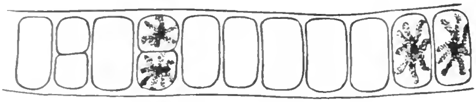

Figure 140

Fig. 140. *Schizogonium murale* Kuetz.

This species and 1 other, *S. crenulatum* (Kuetz.) Gay with short, crinkly filaments, are found in the United States, growing on dripping rocks, or wet soil. The basically filamentous habit may become expanded so that a frond-like thallus is produced. This genus, together with *Prasiola* (Fig. 153) have sufficient structural and reproductive characteristics to warrant placing them in a separate family (Schizogoniaceae) and order (Schizogoniales). The star-shaped chloroplast is helpful in making determinations.

200b Cells mostly longer than wide; 2 chloroplasts 201

201a Chloroplasts 2-6 relatively small and biscuit-shaped or somewhat star-shaped, connected in the midregion of the cell by a strand of cytoplasm inclosing the nucleus; conjugating cells becoming filled with layers of pectic substance; zygospores cushion-like, compressed spheroid, or subquadranguler. Fig. 141 .... *ZYGNEMOPSIS*

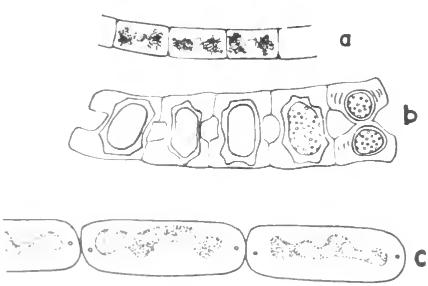

Figure 141

Fig. 141. a. *Zygnemopsis decussata* (Trans.) Trans., vegetative cells with cushion-like chloroplasts; b, conjugation to form zygospores; c, *Z. desmidioides* (West & West) Trans.

The differences between this genus and *Zygnema* occur mostly within the reproductive habit so that determination of plants in the vegetative condition is not certain. The irregular, biscuit-shaped chloroplasts are not conspicuously star-shaped as they usually are in *Zygnema*, a genus which is more commonly found and which includes more species than does *Zygnemopsis*.

201b Chloroplasts different in shape, or if star-shaped, larger than above, and always 2; conjugating cells not becoming filled with pectic substances; zygospores globose, compressed globose, or oval 202

202a Chloroplasts 2, definitely star-shaped, each containing a large central pyrenoid; aquatic. Fig. 142..................*ZYGNEMA*

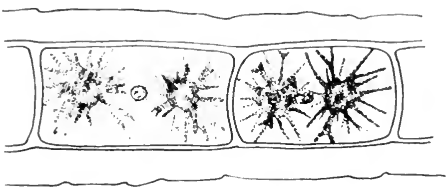

Figure 142

Fig. 142. *Zygnema pectinatum* (Vauch.) C. A. Agardh, vegetative cells showing star-shaped chloroplast.

There are numerous species of *Zygnema*, differentiated on the basis of the zygospore morphology. The paired, star-shaped chloroplasts in each cell make identification of the genus reasonably certain. Frequently the cells are so densely packed with starch grains and cytoplasmic granules that the shape of the chloroplast is difficult of determination. Application of an iodine solution often facilitates observation, or if one examines several lengths of filaments under low magnification the stellate form of chloroplasts will become apparent. A few species have a conspicuous gelatinous sheath.

202b Chloroplasts axial as above but with radiating processes much reduced, sometimes bridged so as to form a dumb-bell shaped mass; terrestrial. Fig. 143......................*ZYGOGONIUM*

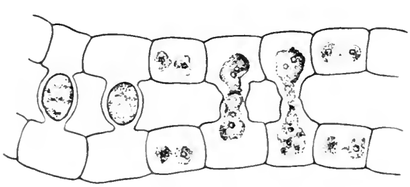

Figure 143

Fig. 143. *Zygogonium ericetorum* Kuetz.

These filaments are somewhat irregular because the cell walls are unevenly thickened and usually are invested by a layer of mucilaginous substance. The cells have the habit of putting out frequent rhizoidal protrusions which may branch. Sometimes the conjugation tubes (when they fail to meet other tubes) will continue to grow as rhizoidal processes. The plant is usually found in aerial or subaerial habitats (occasionally in the water on submerged stumps, etc.).

203a (199) Cell sap purplish...204

203b Cell sap not purplish...205

204a With 2 disc-like chloroplasts. Fig. 144.........*PLEURODISCUS*

Figure 144

Fig. 144. *Pleurodiscus purpureus* (Wolle) Lag., showing disc-like chloroplasts.

There is but one species of this genus reported thus far from the United States. It is a plant easily identified by its unique, plate-like chloroplasts and purple cell sap.

204b With 1 band-like chloroplast. Fig. 145............*MOUGEOTIA*

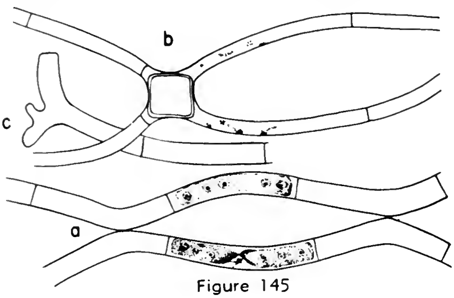

Figure 145

Fig. 145. a, *Mougeotia genuflexa* (Dillw.) C. A. Agardh, showing geniculate or 'knee-bending' type of conjugation and the plate-like axial chloroplast; b, *M. elegantula* Wittr., zygospore with residues in conjugation cells; c, *M.* sp., showing rhizoidal branches.

Like *Spirogyra* (Fig. 147) there are many species of *Mougeotia* separable by zygospore shape and wall markings. Most species have a relatively wide, band-like chloroplast containing a row of large pyrenoids. The chloroplast (axial) is capable of rotating within the cells so that the band, when seen on edge, appears as a narrow ribbon. The shifting of the chloroplast is supposed to be a response to the direction of more favorable illumination.

205a (203) Chloroplasts in the form of spiral ribbons, with many pyrenoids 206

205b Chloroplasts axial bands or plates; pyrenoids 2 to several..208

206a Cell wall densely and minutely granular. See Fig. 106......... ....*GENICULARIA*

206b Cell wall smooth 207

207a Chloroplasts nearly parallel, only slightly twisted; conjugation without the formation of tubes. Fig. 146..........*SIROGONIUM*

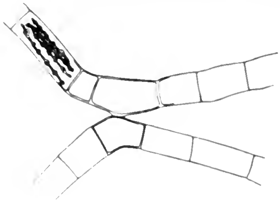

Figure 146

Fig. 146. *Sirogonium sticticum* (Engl. Bot.) Kuetz., showing parallel chloroplasts.

This genus is differentiated from *Spirogyra* (Fig. 147) on the shape and arrangement (nearly straight and parallel) of the ribbon-like chloroplasts, and (in reproductive material) by the absence of a conjugation tube between the cells of adjoined filaments. There is geniculation of filaments to bring the conjugating cells into juxtaposition.

207b Chloroplasts definitely spiralled; conjugation by the formation of tubes from one or both cells, either between cells of two different filaments (scalariform conjugation), or between adjacent cells in the same filament (lateral conjugation). Fig. 147...... ....*SPIROGYRA*

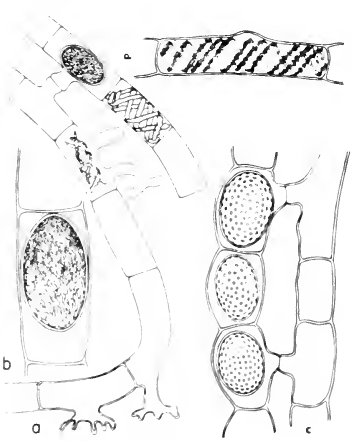

Figure 147

Fig. 147 a, *Spirogyra rhizobrachiales* Jao, showing rhizoidal branches and conjugation; b, zygospore; c, *S. aequinoctialis* G. S. West; d, cell showing chloroplasts and numerous pyrenoids.

This is the most commonly found member of the entire order of Zygnematales. There are numerous species differentiated on the morphology of the zygospore, number of chloroplasts, and size. Chloroplasts alone, and size of cell do not distinguish species in this genus, and identitification of vegetative material cannot be made. *Spirogyra* forms green 'clouds' of cottony growths, usually in quiet water. In the reproductive state the plants appear at the surface, forming cottony mats ('pond scums') and become brown or 'dirty' colored.

208a. (205) Chloroplasts without pyrenoids. Fig. 148 .... *MOUGEOTIOPSIS*

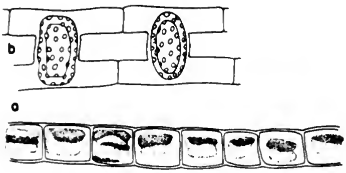

Figure 148

Fig. 148. *Mougeotiopsis calospora* Palla. a, vegetative cells with plate-like chloroplast (without pyrenoid); b, zygospores.

There is only 1 species of this genus reported from the United States, and it is very rare. It is possible to make tentative identification of the species in the vegetative state because the chloroplast is much like that of *Mougeotia*, but without pyrenoids. The cells are characteristically very short cylindric. In reproduction it is similar to *Debarya* (Fig. 149) in that the entire contents of the conjugating cells become fused to form the zygospore.

208b Chloroplasts with 2 to several pyrenoids 209

209a Filaments slender, mostly under 12 μ in diameter (rarely as much as 30 μ or 42 μ); chloroplast a parietal plate, usually not filling the cell; conjugating cells becoming filled with pectic substances; granular residues not found in the emptied reproductive cells; plants rare. Fig. 149 .... *DEBARYA*

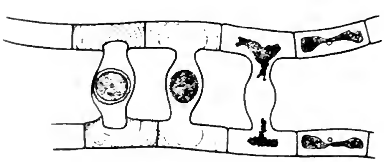

Figure 149

Fig. 149. *Debarya* sp., showing formation of zygospores and the lamellated substance deposited in the conjugating cells.

Species of *Debarya* are like some of the slender species of *Mougeotia* and cannot be differentiated in the vegetative condition. *Debarya* is much less frequently found than *Mougeotia*. In reproduction all of the contents of the conjugating cells enter into the formation of the zygospore and the space once occupied by the protoplasts becomes filled with lamellated substance which is light refractive.

209b Filaments usually wider; chloroplast a broad, axial band with conspicuous pyrenoids, filling the cell laterally (in most species) but not in length; conjugating cells not filled with pectic substances; granular residues present in the emptied reproductive cells; plants common. See Fig. 145 .... *MOUGEOTIA*

210a (198) Plant a cluster of short, erect filaments (usually is branched but sometimes appears unbranched when young; some species form attached discs). Fig. 150..................*COLEOCHAETE*

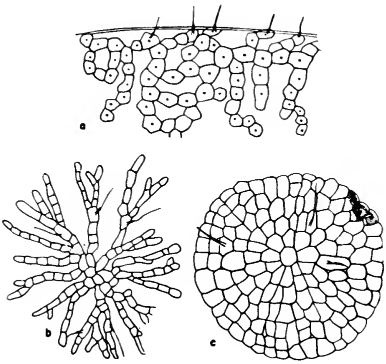

Figure 150

Fig. 150 a, *Coleochaete Nitellarum* Jost; b, *C. soluta* (Breb.) Pringsh.; c, *C. orbicularis* Pringsh.

There are 4 or 5 species of this genus which are commonly found in this country. They are differentiated by habit of growth (prostrate or in cushion-like tufts) and by size of cells. One species, *C. Nitellarum* Jost, occurs only in the walls of *Nitella* (Fig. 3) and is nearly always found wherever the host plant occurs. The endophyte shows especially well when *Nitella* is allowed to deteriorate in a laboratory container. The sheathed seta which characterizes *Coleochate* arises from a granule (the blepharoplast) within the cell and emerges through a pore in the wall. The disc-like thallus formed by some species of *Coleochaete* is frequently found on the sides of glass aquaria. In nature they occur on other algae or on submerged stems of cattail, or on submerged glass and crockery.

210b Plant not in the form of a cushion of erect filaments.........211

211a Thallus a macroscopic expanded sheet, one cell in thickness (usually in salt water, but occasionally found in brackish and fresh water); attached at one end. Fig. 151.....*MONOSTROMA*

Figure 151

Fig. 151. *Monostroma latissimum* (Kuetz.) Wittr.

In salt water this genus includes species which form large thalli many centimeters long and wide, whereas in freshwater the plants are much smaller. Salt water species are sometimes carried inland and become distributed when oyster shells are thrown into freshwater habitats.

211b Thallus not a large, flat sheet, not so attached..............212

212a Thallus an intestiniform, hollow tube, with the wall one cell in thickness. Fig. 152 .... *ENTEROMORPHA*

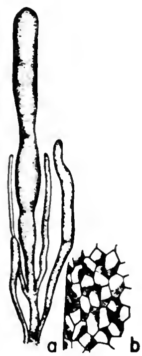

Figure 152

Fig. 152. *Enteromorpha intestinalis* (L.) Grev. a, habit of branched thallus; b, cells showing parietal position of chloroplasts.

Like *Monostroma* (Fig. 151) *Enteromorpha* is primarily a marine alga but becomes adapted rather easily to freshwater habitats. The long, hollow tubes are frequently branched, forming slender threads or crinkled tubes. The plants are always attached to submerged plant stems, or to stones, especially in flowing water. There are eight species known from freshwater or brackish situations.

212b Thallus not an intestiniform tube 213

213a Plant a lobed or ruffled disc of cells, 10 cm. or less across; attached by a central short stipe (usually on rocks in alpine and arctic situations). Fig. 153 .... *PRASIOLA*

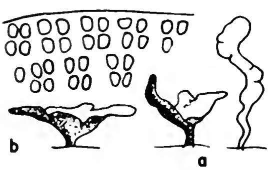

Figure 153

Fig. 153. *Prasiola crispa* (Lightf.) Menegh. a, several forms of thallus; b, diagram to show cells in 4's.

Four species of *Prasiola* have been reported from the United States, mostly from alpine and subalpine situations. In the Arctic the plants are common on soil rich in nitrogenous wastes. The thalli are foliose or frond-like sheets, attached at a central point by a short stalk or disc. The genus and *Schizognium* (Fig. 140), comprising the Schizogoniaceae, have star-shaped, axial chloroplasts.

213b Plant otherwise; a filament or a gelatinous strand 214

214a A filament of cells 221

214b A gelatinous strand, or a tube, or a plant including a gelatinous tube which may or may not have cross partitions 215

215a Thallus a tube-like strand (sometimes forked), containing many lamellations (layers); cells at the tips of the tubes. Fig. 154... *HORMOTILA*

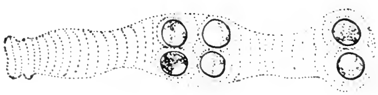

Figure 154

Fig. 154. *Hormotila mucigena* Borzi.

This curious plant is a branched colonial form by virtue of the fact that as the cells divide they secrete mucilage and construct gelatinous strands that branch and re-branch, the cells always occurring at the distal ends of the strands. The plant (one species only being known) is classed near *Gloeocystis* (Fig. 41) in the Tetrasporales (Palmellaceae).

215b Thallus not as above..................................216

216a Cells located at the ends of undivided tubes, the cell bearing a seta with a sheathed base. See Fig. 62...*CHAETOSPHAERIDIUM*

216b Cells without setae..................................217

217a Cells constricted in the middle, occurring at the ends of tubes which are united in colonies that are impregnated with lime. Fig. 155 .... *OOCARDIUM*

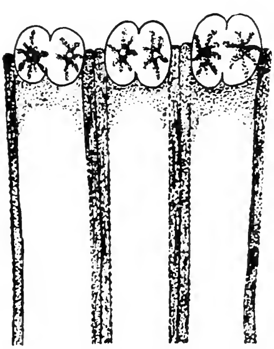

Figure 155

Fig. 155. *Oocardium stratum* Naeg.

This is a very rare desmid, or at least it has been reported but few times, probably because it is overlooked by collectors. The *Cosmarium*-like cells occur in colonies at the ends of branched gelatinous strands and are inclosed in a firm sheath of lime. They are to be sought on encrustations of rocks in dripping or flowing water.

217b Cells not constricted in the midregion, not arranged as above..218

218a Cells in tubes which are attached to microfauna. See Fig. 64. ....COLACIUM

218b Cells not attached to microfauna............................219

219a Cells elongate-oval; brackish water or marine. Fig. 156....... ....PRASINOCLADUS

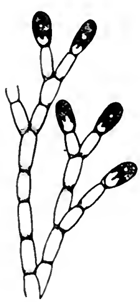

Figure 156

Fig. 156. *Prasinocladus lubricus* Kuck.

Although essentially marine this species has been known to occur in brackish water. It is an attached, branching tube composed of a series of compartments, forming a tree-like thallus, in which the oval protoplasts occur only at the tips of the branches. There is one chloroplast at the forward end of the cell which actually is the posterior pole because like some of its relatives (*Malleochloris*, Fig. 95) the cells are in an inverted position with the anterior end downward.

219b Cells round, not in brackish water habitats................220

220a Cells in 1 series or in several irregular series within simple or branched tubes; chloroplasts 2 laminate. See Fig. 45......... ....PALMODICTYON

220b Cells in several series, arranged in clusters of 4 in an irregularly shaped, elongate strand of mucilage; chloroplast 1, a parietal cup. See Fig. 35...................................TETRASPORA

221a (214) Filament of cells in 1 series, at least in the basal portion. 222

221b Filament of cells in more than 1 series, at least in the upper portion 239

222a Filament of cells in 1 series in the basal portion, of several series in the upper. Fig. 157....................*SCHIZOMERIS*

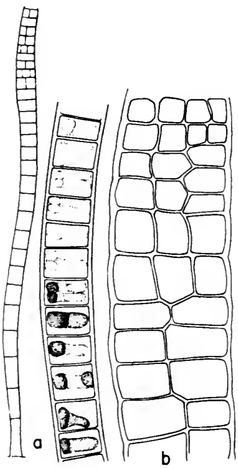

Figure 157

Fig. 157. *Schizomeris Leibleinii* Kuetz. a, base of filament and uniseriate portion; b, multiseriate upper portion of filament.

There is but 1 species in this genus, a plant which is uncommon but widely distributed over the world. The filaments are relatively large, when fully developed, and rather coarse. They occur in dark green clumps in standing water and have the macroscopic appearance of a growth of *Spirogyra* (Fig. 147) or of some large *Ulothrix* (Fig. 167), but unlike these genera, *Schizomeris* filaments separate easily and can be seen individually within the tuft. There is some evidence that the plant favors water rich in nitrogenous matter and is to be looked for in shallow water of lakes near the entrance of drains, effluent of sewage treatment plants, etc.

222b Filaments of cells in 1 series throughout....................223

223a Chloroplast a parietal network, usually close and dense, covering the entire wall; pyrenoids many and conspicuous.......224

223b Chloroplast otherwise; pyrenoids few or lacking............225

224a Cells cylindrical, usually many times their diameter in length (sometimes only 3 times longer than wide); wall thick. Fig. 158. .... *RHIZOCLONIUM*

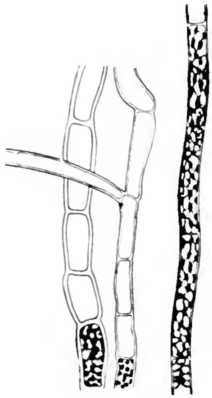

Figure 158

Fig. 158. *Rhizoclonium Hookeri* Kuetz.

The species belonging to this genus are all coarse, wiry, and but very little (if at all) branched. The filaments are composed of relatively long, cylindrical cells with thick walls which frequently show lamellations, especially near the cross walls. There are numerous chloroplasts, often compactly arranged and difficult of determinaiion in respect to shape and organization. There are many pyrenoids. The branches are usually short and mostly at right angles to the main axis, but when they are long these plants intergrade with some forms of *Cladophora* (Fig. 192), in which the branching habit has been reduced. *Rhizoclonium* forms dense, tangled filamentous mats in standing water, or long, stringy, sometimes rope-like strands in flowing water. *R. hieroglyphicum* (Ag.) Kuetz. is the most common species, one which has rather uniformly cylindrical cells with relatively thin walls, and does not branch.

224b Cells not cylindrical, slightly larger at the anterior end, or even when appearing cylindrical always with at least 1 ring-like scar at the anterior end just below the cross wall. Fig. 159.......... .... *OEDOGONIUM*

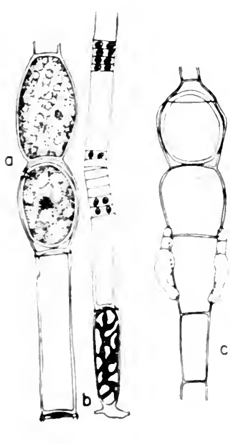

Figure 159

Fig. 159. a, *Oedogonium crispum* Kuetz., portion of filament with one fertilized and an unfertilized egg; b, basal hold-fast cell and portion of a filament containing antheridia and antherozoids; c, Oe. *Westii* Tiffany, showing dwarf male filaments epiphytic on the female plant.

There are over 250 species in this large genus which belongs to a family (Oedogoniaceae) in which there are only two other genera (*Bulbochaete*, Fig. 195; *Oedocladium*, Fig. 174). Species are differentiated by the size and morphology of the sexual reproductive organs and by the shape, decoration, and size of the mature zygospore (oospore). Whereas some species have the male organs (antheridia) in filaments the same size as the female, others possess dwarf male plants that grow as epiphytes on or near

the female gametangium (oogonium). *Oedogonium* plants begin as attached filaments and may remain so throughout life, or they may become free-floating and form cottony masses near the surface, usually becoming pale yellow-green or cream-colored in age. Often these masses are so dense that if left to dry by the evaporation of water in which they are growing they form what is known as "algae paper."

225a (223) Chloroplast a parietal plate, a ring, or a band which incompletely encircles the cell............................226

225b Chloroplast massive and dense (difficult of determination), or a parietal sheet of thick and thin areas (padded appearance), or a branched, beaded thread (see *Microspora*). Fig. 159½. 237

Figure 159½

226a Filaments composed of long, cylindrical, multinucleate units; chloroplasts in the form of several parietal rings in each unit. Fig. 160.....................................*SPHAEROPLEA*

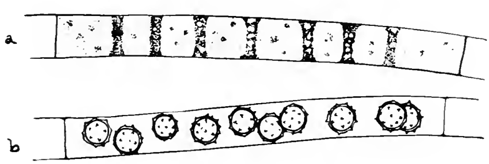

Figure 160

Fig. 160. *Sphaeroplea annulina* (Roth) Ag.; a, vegetative cell with ring-like chloroplasts, and b, one cell containing fertilized eggs.

Two species of this genus are known from the United States, but *S. annulina* is the one most frequently seen, although it actually is a rather rare plant. Wherever it occurs it is likely to be in abundance. The characteristic long, cylindrical 'cells' may be mistaken for species of *Rhizoclonium* (Fig. 158), especially in the examination of preserved material. It is to be expected in shallow water of marshes and in bays of lakes.

226b Filaments not composed of long, multinucleate units; chloroplasts otherwise, usually 1 in each cell..........................227

227a Filaments prostrate, creeping on larger filamentous algae. Fig. 161 .... *APHANOCHAETE*

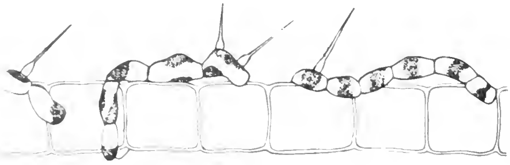

Figure 161

Fig. 161. *Aphanochaete repens* A. Br.

There are 3 species of this genus which are very common but are often overlooked because of their small size and their habit of creeping on the walls of larger filamentous algae. The simple setae, with their swollen bases extending from the cell wall are helpful in making identification. *A. polychaete* (Hansg.) Fritsch is characterized by having several setae on each cell.

227b Filaments not creeping on algae; floating or if prostrate, with cells in discontinuous series.... 228

228a Filaments very short (up to 20 cells); often in interrupted series. 229

228b Filaments longer, in continuous series......................230

229a Chloroplast a parietal plate extended over but a small part of the wall; usually subaerial. Fig. 162...........*STICHOCOCCUS*

Figure 162

Fig. 162. *Stichococcus bacillaris* Naeg.

The difference between *Stichococcus* and the small filaments characteristic of *Hormidium* (Fig. 168) is difficult to define. In the former genus the filaments are usually relatively short (10 to 40 cells) and have a tendency to break into short segments intermittently. Of the 6 species which occur in the United States most are found on the bark of trees, old boards, or on damp soil. The species illustrated is the most common, often occurring with *Protococcus* on the moist bark of trees, the short filaments twisted and contorted, or coiled in one plane.

229b Chloroplast a broad plate extended over most of the cell wall; aquatic. Fig. 163 .... ***HORMIDIOPSIS***

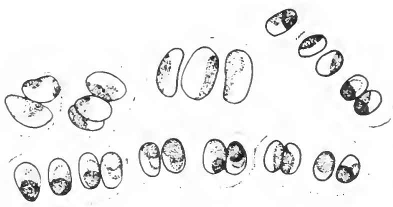

Figure 163

Fig. 163. *Hormidiopsis ellipsoideum* Pres.

This is the only species reported from this country and possibly cannot be differentiated from *Hormidium* (Fig. 168) except that the filaments are frequently interrupted and constricted at the joints, the cells being oblong or oval rather than cylindrical. Characteristically, the chloroplast extends but only part way around the cell wall.

230a Filament composed of units which include 2 oval or subspherical protoplasts; the space between protoplasts and the walls filled with layered (lamellose) material. Fig. 164 .... ***BINUCLEARIA***

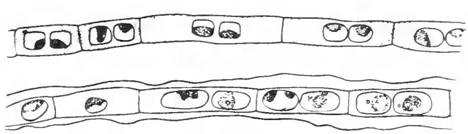

Figure 164

Fig. 164. *Binuclearia tatrana* Wittr., one filament showing a gelatinous sheath.

This is the only species reported from the United States; occurs intermingled with other filamentous algae, especially in mixtures taken from bogs. The paired protoplasts within each unit of the filament make it easy of identification.

230b Filaments of cells without paired protoplasts as above **231**

231a Filaments with a gelatinous sheath **232**

231b Filaments without a gelatinous sheath **235**

232a Cells cylindric-quadrate, globose or ellipsoid; adjoined at the end walls **233**

232b Cells oblong, not adjoined at the end walls. Fig. 165 .... *GEMINELLA*

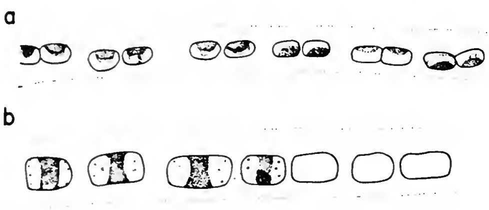

Figure 165

Fig. 165. a, *Geminella interrupta* (Turp.) Lag.; b, *G. mutabilis* (Breb.) Wille.

These are filamentous plants which have cylindrical or broadly oval cells encased in a wide sheath of mucilage. The cells may be adjoined, or rather evenly spaced one-half to 2 cell lengths apart. Like *Hormidium* (Fig. 168) the chloroplast covers but a small portion of the wall.

233a Cells quadrate or cylindrical; cell wall in 1 piece..........234

233b Cells globose, subglobose, or ellipsoid, wall usually of 2 overlapping pieces that meet in the midregion of the cell and form short lateral projections (resulting from a rim about the cell in center). Fig. 166.............................*RADIOFILUM*

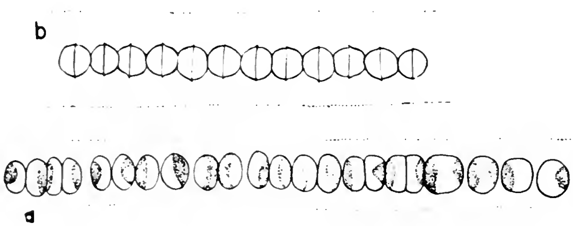

Figure 166

Fig. 166. a, *Radiofilum flavescens* G. S. West; b, *R. conjunctivum* Schmidle.

The globose or subglobose cells of these filaments help to separate them from *Geminella* (Fig. 165) which also possesses a gelatinous sheath. Some species (*R. conjunctivum* Schm., e. g.) have the wall in 2 sections which form a rather conspicuous overlapping in the mid region. There are 3 species in this country, differentiated by shape and size of the cells.

234a Chloroplast a parietal band or ring which encircles the cell or nearly so. Fig. 167 .... *ULOTHRIX*

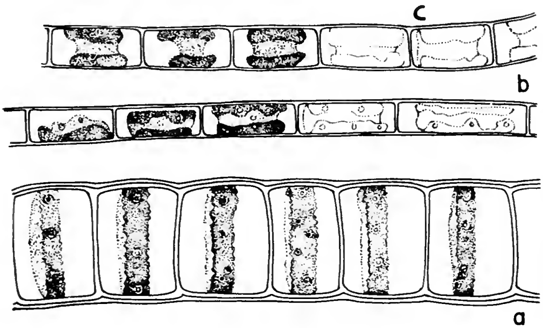

Figure 167

Fig. 167. a, *Ulothrix zonata* (Weber & Mohr) Kuetz., with ring-like chloroplast; b, *U. cylindricum* Presc.; c. *U. aequalis* Kuetz.

Species of this genus vary greatly in size and proportions of the cells. Some are shorter than wide, others distinctly cylindrical. The most familiar species, and the largest is *U. zonata* (Fig. 167a) which has a basal holdfast cell and chloroplasts which completely encircle the cell wall. Others have a chloroplast that forms two-thirds to three-fourths of a circle. Usually there are 1 or more conspicuous pyrenoids. Whereas most species occur in standing water, *U. zonata* may be found in streams and usually in rather cold habitats.

234b Chloroplast a laminate plate lying over a small portion of the wall and not encircling it. See Fig. 165 .... *GEMINELLA*

235a (231) Filaments not showing a basal-distal differentiation. Fig. 168 .... *HORMIDIUM*

Figure 168

Fig. 168. *Hormidium Klebsii* G. M. Smith.

This genus includes several species of simple, unbranched filaments of cylindrical cells which are characterized by having chloroplasts which extend only part way around the cell and which are only about one-half the cell in length.

235b Filaments with a basal holdfast 236

236a Cells elongate-cylindric, the apical cell unsymmetrically pointed. Fig. 169 . . . . *URONEMA*

Figure 169

Fig. 169. *Uronema elongatum* Hodgetts.

This is the only species in a genus of questionable position. The cells are long and cylindrical with a *Ulothrix*-like chloroplast. Usually the filament is only a few cells in length. The unsymmetrically pointed apical cell is the chief identifying character. Young stages in the development of *Stigeoclonium* plants should be kept in mind when identification of *Uronema* is made.

236b Cells short-cylindric, apical cell not tapering. See Fig. 167. . . . . *ULOTHRIX*

237a (225) Cells quadrate or oval to subglobose, inclosed in a stratified gelatinous sheath. Fig. 170 . . . . *CYLINDROCAPSA*

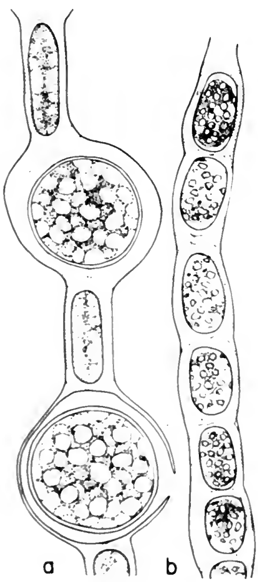

Figure 170

Fig. 170. *Cylindrocapsa geminella* var. *minor* Hansg. a, portion of filament with oogonia; b, vegetative cells.

Although filaments of this genus begin as attached plants they soon become free-floating and are found intermingled with other filamentous algae, especially in soft water or acid lakes. The chloroplasts are so dense and the cell contents include so much food storage material that few structural characteristics can be determined. The female reproductive organs are globular and greatly swollen, often red in color, as are the antheridia which occur as series (sometimes double) of smaller cells.

237b Filaments formed otherwise **238**

238a Cells orange or golden-red because of haematochrome; plants aerial on trees and rocks; chloroplast dense and indeterminate of shape. Fig. 171 . . . . ***TRENTEPOHLIA***

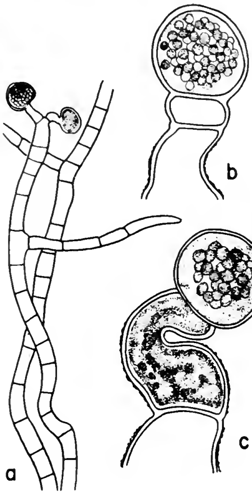

Figure 171

Fig. 171. *Trentepohlia Iolithus* (L.) Wallroth. a, filament with 2 terminal sporangia; b, c, sporangia in detail.

This species and *T. aurea* Mart. are the 2 which are the most common of the 6 which have been reported from the United States. They grow on moist stones, dripping cliffs, and on the moist bark of trees. The characteristic orange color makes this plant conspicuous, especially when it forms extensive patches, sometimes forming a felty-mat over large areas of rocky cliffs. In southern United States the moist sides of trees throughout large areas of the countryside are colored reddish by these algae. In humid situations of the tropics and subtropics the filaments become infested with a fungus to form the lichen, *Coenogonium*. The haematochrome pigment appears in the cell as a reaction to intense illumination.

238b Cells without haematochrome; plants aquatic; chloroplast a perforated and padded sheet or a branched, beaded ribbon. Fig. 172 . . . . ***MICROSPORA***

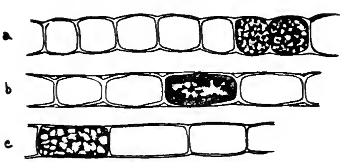

Figure 172

Fig. 172. a, *Microspora Loefgrenii* (Nordst.) Lag.; b, *M. Willeana* Lag.; c, *M. floccosa* (Vauch.) Thur.

In this genus the simple, unbranched filaments have chloroplasts that vary greatly in respect to the degree with which they cover the wall. There are 5 or 6 species, differentiated by cell size and proportions, and by thickness of the wall. Some species show the 2-parted character of the wall, especially at the ends of the filaments where the line of separation having occurred in the midregion of the cell rather than at the juncture of 2 cells, forms characteristic H-shaped pieces.

239a (221) Plants macroscopic; embedded in soft mucilage; a main axis with whorls of branches giving the thallus a beaded effect that is visible to the unaided eye. Fig. 173....***BATRACHOSPERMUM***

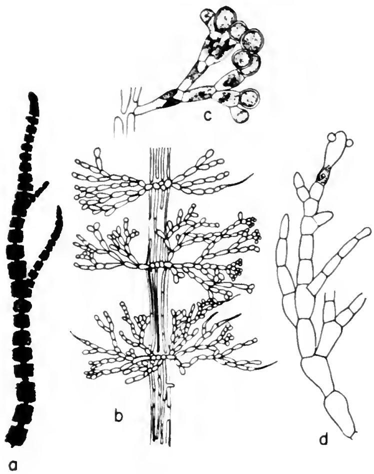

Figure 173

Fig. 173. a, *Batrachospermum moniliforme* Roth, habit of plant; b, portion of thallus showing small antheridial cells at tips of branches; c, *B. vagum* (Roth) Ag., antheridial branch in detail; d, *B. Boryanum* Sirod., carpogonial branch with 2 male cells attached to trichogyne of the carpogonium (female organ).

This genus belongs to the red algae (Rhodophyta) although it shows none of the red color characteristic of this group of algae as they occur in the ocean. The macroscopic thalli, highly branched and beaded in appearance, encased in copious mucilage make these plants easily identified. The thallus may be gray-green or blue-green, or olive in color. *B. vagum* is perhaps the most common species in this country, often occurring in large patches over stones in flowing water. Some species prefer quiet water and are to be sought in *Sphagnum* bog pools. Microscopically it is one of the finest appearing genera of fresh water algae.

239b Plants microscopic, or if macroscopic, not showing whorls of branches 240

240a Filaments uniseriate below, becoming multiseriate above with cells brick-like in shape and arrangement; cells adjoined. See Fig. 157..***SCHIZOMERIS***

240b Filaments multiseriate throughout; cells not adjoined but arranged in irregular linear series within a gelatinous strand to form a false filament. See Fig. 45.................. ***PALMODICTYON***

241a (189) Plants composed of cells or of cellular units; cross walls present 242

241b Plants multinucleate filaments (coenocytes), without cross walls (except when reproductive structures are developed and separated by a cross partition from the main filament).......... 281

242a Plants growing on moist soil with rhizoidal branches composed of long, narrow cells; apical cell usually with a cap (thimble). Fig. 174.......... *OEDOCLADIUM*

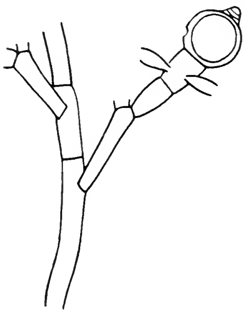

Figure 174

Fig. 174. *Oedocladium Hazenii* Lewis, portion of branched filament with an oogonium and 2 epiphytic male plants.

This genus includes but 3 or 4 species in this country, growing on damp soil. There may be many species in the genus but are unknown because collections are so seldom made from soil, and because in superficial macroscopic appearance the growth may be mistaken for moss protonema.

242b Plants aquatic; parasitic on higher plants, or if terrestrial, without long narrow rhizoidal branches and without terminal cap.... 243

243a Plants prostrate, growing horizontally; mostly epiphytic or endophytic; upright branches sometimes lacking; forming discs or flat expansions 244

243b Plants not growing entirely prostrate, at least in part with erect branches; free-floating, parasitic on higher plants, or perforating wood and shells.......... 256

244a Thallus a freely-branched filament; cells usually bearing setae or hairs.......... 245

244b Thallus not freely-branched but forming a disc or flat expansion of cells; sometimes forming a false cushion (pseudoparenchymatous) 251

245a Endophytic in walls of other algae..........................246

245b Not endophytic in walls of other algae....................247

246a Cells bearing setae which are sheathed at the base. See Fig. 150. ....*COLEOCHAETE*

246b Cells not bearing setae. Fig. 175................*ENTOCLADIA*

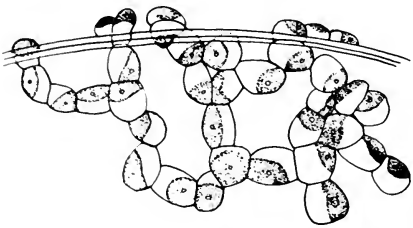

Figure 175

Fig. 175. *Entocladia polymorpha* (G. S. West) G. M. Smith.

This genus includes only 2 known species in the United States. Although probably very common it is easily overlooked because the thalli are small and grow inconspicuously within the walls of larger algae.

247a (245) Some cell walls bearing setae with a sheathed base; terminal cells of branches not tapering to form hairs. See Fig. 150...... ....*COLEOCHAETE*

247b Cells with setae that are not sheathed at the base, or if without, ends of branches tapering to form hairs....................248

248a Setae and terminal hairs multicellular.....................249

248b Setae one-celled..250

249a Multicellular setae arising from lateral walls of the cells. Fig. 176. ....*PSEUDOCHAETE*

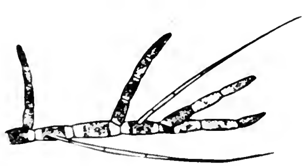

Figure 176

Fig. 176. *Pseudochaete gracilis* West & West.

This species is rarely found, growing partly prostrate, partly erect on submerged plants or other substrates. The branched filaments taper at both ends. Some of the lateral branches form long, narrow and finely tapering hairs. Some authorities regard *Pseudochaete* as a form of *Stigeoclonium*. See Fig. 177.

249b Multicellular hairs resulting from the apical tapering of branches. Fig. 177.................................*STIGEOCLONIUM*

Fig. 177. a, *Stigeoclonium flagelliferum* Kuetz.; b, cell showing laminate chloroplast and pyrenoid.

Figure 177

There are several species of this genus which are differentiated by size, by order of branching and by the morphology of the thallus as a whole, some forming long, graceful tufts, others more bunched growths, with part of the thallus prostrate.

250a Growing in the mucilage of other algae. Fig. 178...*CHAETONEMA*

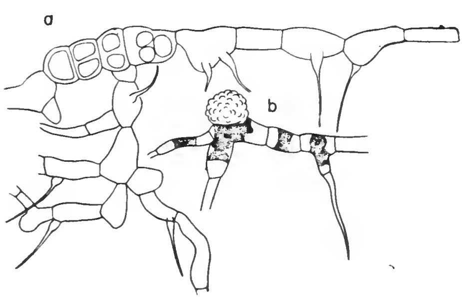

Figure 178

Fig. 178. *Chaetonema irregulare* Nowak. a, branches containing antheridial cells; b, oogonium.

There is only 1 species of this genus known, rather rarely seen because its habitat is the gelatinous matrix of highly branched algae such as *Chaetophora* (Fig. 196).

250b Growing or creeping on the walls of larger algae. See Fig. 161. ....*APHANOCHAETE*

251a (244) Cells bearing setae with sheathed bases. See Fig. 150. .... *COLEOCHAETE*

251b Cells without setae, or if setae present, without sheathed bases. 252

252a Endophytic in the walls of other algae. See Fig. 175. .... *ENTOCLADIA*

252b Not endophytic in the walls of other algae 253

253a Some cells bearing setae. Fig. 179 .... *CHAETOPELTIS*

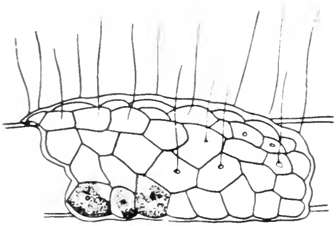

Figure 179

Fig. 179. *Chaetopeltis orbicularis* Berth.

This plant forms relatively small circular discs composed of indistinctly radiating filaments closely grown together side by side. It should be compared with *Coleochaete* (Fig. 156). Almost every cell in the thallus bears a long, very slender, hair-like seta.

253b Setae lacking 254

254a Thallus a thin expansion, 1 cell in thickness; a circular disc or a somewhat irregular expansion. Fig. 180 .... *PROTODERMA*

Fig. 180. *Protoderma viride* Kuetz.

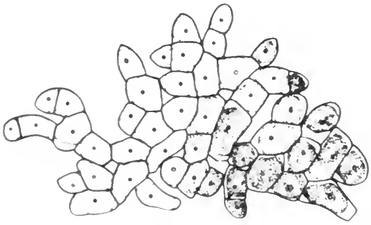

Figure 180

This prostrate plant forms a cushion-like thallus 1 cell in thickness at the margin and one which shows very irregular branching of short filaments. It is to be found growing on the stems of submerged aquatic plants.

254b Thallus cushion-like, several cells in thickness 255

255a Cells with several chloroplasts; thallus inclosed in a mucilaginous sheath. Fig. 181............................*PSEUDOULVELLA*

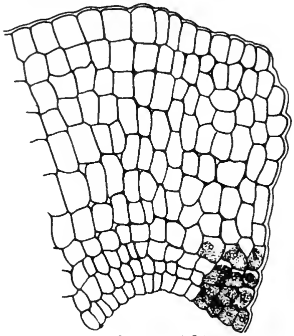
Figure 181

Fig. 181. *Pseudoulvella americana* (Snow) Wille.

The prostrate disc-like thalli of this plant are relatively large, 1 cell in thickness at the margin, several cells thick near the center. The entire plant is covered by a gelatinous film through which an occasional seta projects from the cell walls, but these are rarely found.

255b Cells with 1 reticulate chloroplast; thallus not inclosed in a sheath. Fig. 182.......................................*ULVELLA*

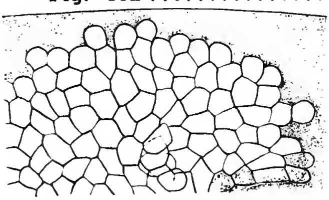
Figure 182

Fig. 182. *Ulvella involens* (Savi) Schmidle (*Dermatophyton*), diagram of attached colony showing arrangement of cells.

This plant forms irregular disc-like or cushion-like growths which are several cells in thickness when mature. They grow on submerged aquatic plants, sometimes on animals; do not possess setae.

256a (243) Plants parasitizing leaves of terrestrial Angiosperms (magnolia, tea, etc.). Fig. 183.......................*CEPHALEUROS*

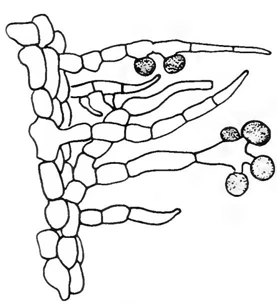
Figure 183

Fig. 183. *Cephaleuros virescens* Kunze, diagram of thallus as it grows under leaf epidermis of host plant, with erect branches bearing sporangia.

This species occurs in tropical and subtropical parts of the world, especially in areas where there is an optimum humidity so that the leaves of the plants on which the alga is parasitic are moist. The host may be *Magnolia*, tea (*Thea*), citrus trees, or *Rhododendron*. Because of the discoloration and degeneration of host tissue in the vicinity of the parasite some damage is caused by this alga and a certain amount of economic loss results, especially in tea plantations. Although the parasitized areas appear gray-green in color, the individual filaments of the cushion-like thallus of the alga are usually reddish because of the contained haematochrome pigment.

256b Plants not parasitizing tissues of Angiosperms..............257

257a Cells without setae; filaments not tapering to hair-like tips...258

257b Cells bearing setae or with branches tapering to fine points..276

258a Branches short, irregular and rhizoidal, often formed only near one end of the filament....................................259

258b Branches long, multicellular, usually forming a definite pattern of growth, opposite or alternate on the main axis............261

259a Chloroplast a spiral ribbon. See Fig. 147..........*SPIROGYRA*

259b Chloroplast not a spiral ribbon..............................260

260a Chloroplast an axial plate or band. See Fig. 145...*MOUGEOTIA*

260b Chloroplast a parietal network of thickenings and thin strands. See Fig. 158...............................*RHIZOCLONIUM*

261a Growing in wood, shells, or within limestone. Fig. 184.......... ....*GOMONTIA*

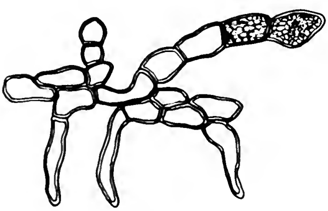

Figure 184

Fig. 184. *Gomontia Holdenii* Collins, habit of thallus showing erect branches.

These plants must be sought within old wood, shells, or in limestone deposits. The thallus occurs as a cushion-like, irregularly tangled mass of short filaments from which some elements grow downward to form rhizoidal penetrating threads. Reproductive structures (sporangia) are borne on the upper part of the thallus or on the ends of short erect branches. Most species are marine.

261b Not growing in wood nor in shells..........................262

262a Growing on trees or moist rocks; many or all cells showing an abundance of orange or reddish-yellow pigment (haematochrome). See Fig. 171..................................*TRENTEPOHLIA*

262b Plants growing elsewhere, not containing haematochrome.....263

263a Thallus encrusted with lime................................264

263b Thallus not encrusted with lime............................265

264a Thallus in the form of a cushion, giving rise to compactly arranged upright branches; cells broadest near the tip of the filaments; growing on wood or shells (sometimes on other plants). Fig. 185..*GONGROSIRA*

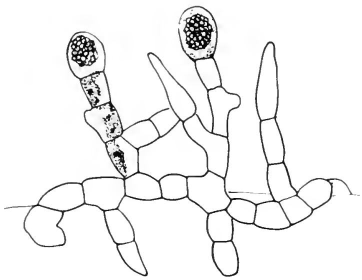

Figure 185

Fig. 185. *Gongrosira Debaryana* Rab., horizontal and erect branches with terminal sporangia.

Like *Gomontia* (Fig. 184) these plants grow on shells and submerged wood, or on aquatic plants, but form external cushion-like masses (often encrusted with lime) rather than penetrating the substrate. The erect branched portion of the thallus is more extensively developed than in *Gomontia*. The chloroplast is parietal and usually more definite in outline than that of *Gomontia* which may be padded and irregularly netted.

264b Thallus composed of loosely branched filaments, the branches arising unilaterally. Fig. 186..................*CHLOROTYLIUM*

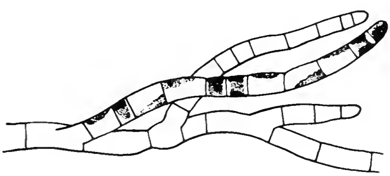

Figure 186

Fig. 186. *Chlorotylium cataractum* Kuetz., portion of plant showing characteristic habit of branch development.

The attached, lime-encrusted thalli of this branched filamentous plant are usually found in flowing water. The filaments present a distinctive appearance when seen microscopically because pairs of short, green cells (often with a reddish tinge) alternate with a more elongate and sometimes nearly colorless cell.

265a (263) Thallus in the form of a tuft of dichotomously branched, radiating, yellowish-green filaments. Fig. 187.......*LEPTOSIRA*

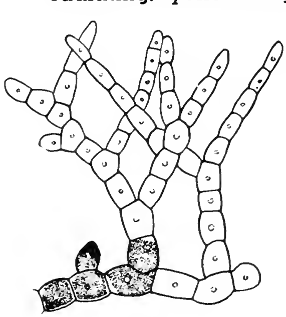

Figure 187

Fig. 187. *Leptosira Mediciana* Borzi, portion of plant showing horizontal and erect branching systems.

This species is known only from Massachusetts and Kentucky in this country. Filaments occur in yellowish tufts and are usually attached to subtrates in the water. The irregularly branched filaments of bead-like or barrel-shaped cells arising from a prostrate portion of the thallus help in making identification.

265b Thallus not a dense tuft of yellow-green filaments...........266

266a Bearing enlarged, thick-walled akinetes (vegetative spores) among the cylindrical cells of the filament, or with spores at the ends of branches...........267

266b Without akinetes...........268

267a Akinetes globular. Fig. 188...........*CTENOCLADUS*

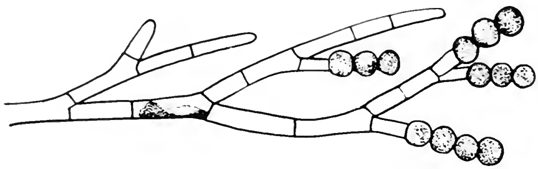

Figure 188

Fig.188. *Ctenocladus circinnatus* Borzi., showing a terminal series of akinetes.

This is a branched filamentous species, growing epiphytically on angiospermous plants in brackish water. The chains of globular akinetes at the ends of branches make it distinctive, although the habit of growth is somewhat like *Gongrosira* (Fig. 185).

267b Akinetes barrel-shaped or oval. Fig. 189........*PITHOPHORA*

Fig. 189. a, *Pithophora Mooreana* Collins; b, *P. Oedogonia* (Mont.) Wittr., showing a sample of the chloroplast.

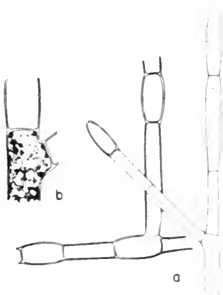

Figure 189

There are 3 or 4 species of this irregularly branched, filamentous genus in this country, differentiated by dimensions of the filament and by size and shape of the much-swollen akinetes that are formed intermittently throughout the plant. When occurring in laboratory aquaria, having been brought in on material obtained from biological supply houses, the filaments often fail to develop akinetes, the cells becoming exceedingly long and lose some of the appearance by which they are usually identified.

268a (266) Growing on submerged wood and stones with a prostrate cushion-like mass of branches from which vertical branches arise. See Fig. 185 .... *GONGROSIRA*

268b Thallus formed differently 269

269a Plants growing on shells of turtles; branching arising only from the base of the main filament. Fig. 190 .... *BASICLADIA*

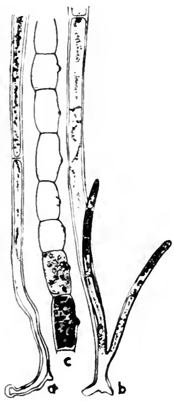

Figure 190

Fig. 190. *Basicladia Chelonum* (Collins) Hoffman & Tilden. a, cells at base of filament; b, branching habit; c, series of sporangia formed in upper portion of filament.

This and 1 other species (differentiated mostly by size) comprise the genus which is distinctive in that the plants occur only on the shells of turtles, especially the snapper. Old turtles are usually "mossy" with the tufted growths of filaments which characteristically branch so close to the base that the branching habit is easily overlooked. Cells may be as much as 120 μ in diameter but a millimeter or two in length.

269b Plant not growing on turtles, or with other types of branching . . 270

270a Plants showing basal-distal differentiation, usually attached (floating in age); branching arbuscular (tree-like or bush-like) 271

270b Plants not forming bushy growths 274

271a Cells with haematochrome (reddish color in the chloroplasts). See Fig. 171 .... *TRENTEPOHLIA*

271b Cells without haematochrome 272

272a Plants stout; walls thick and lamellate; chloroplast a dense reticulum with many pyrenoids 273

272b Plants slender, very minute (not more than 5 μ in diameter); wall thin; cross wall at the base of a branch above the level of origin from the main axis. Fig. 191 .... *MICROTHAMNION*

Fig. 191. *Microthamnion strictissimum* Rab.

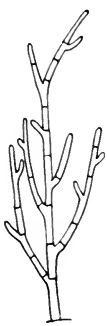

Figure 191

This species and its relative, *M. Kuetzingianum* Naeg. are easily overlooked in collections because the attached filaments are so minute and the chloroplast often so nearly colorless. They occur on larger filaments of other organisms but usually break away and are found floating free at maturity, intermingled with other algae.

273a Branching open and spreading; cells mostly cylindrical. Fig. 192. .... *CLADOPHORA*

Fig. 192. *Cladophora* spp. a, cell showing parietal, net-like or discontinous chloroplast; b, habit of branching.

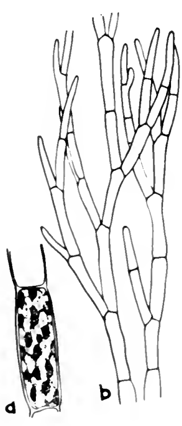

Figure 192

There are numerous species of this genus both in fresh and in salt water. They are differentiated by size, shape of cell, and plan of branching. The habit of branching is variable according to habitat and species definitions, therefore, are poorly made. Some plants exist over winter in lakes and become wave-washed and lose their original appearance. Other species in lakes become free-floating and by wave action become rolled over and over with the result that "*Cladophora*-balls" are produced. These appear as densely branched and entangle l growths, with cells very irregular in shape. Perhaps the most characteristic habitat of *Cladophora* is on rocks in flowing water, especially on dams and waterfalls.

273b Branching close and entangled, often dichotomous; downward projecting rhizoidal branches common; cells irregularly swollen. Fig. 193 .... *AEGAGROPILA*

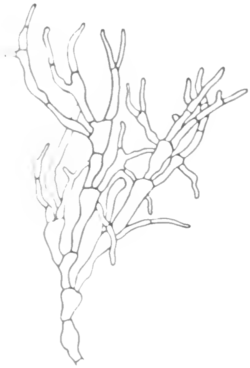

Figure 193

Fig. 193. *Aegagropila profunda* (Brand) Nordst.

This species is more irregularly branched than *Cladophora* and has downward directed rhizoidal branches. The upper filaments are densely entangled and the cells are more irregular in shape. As the species name suggests, it is found growing on the bottom of lakes at depths up to 200 feet (especially in clear water). Some authorities include *Aegagropila* under *Cladophora*.

274a (270) Vegetative cells very long and cylindrical, somewhat regularly interrupted by swollen, thick-walled cells (akinetes). See Fig. 189.................................... *PITHOPHORA*

274b Akinetes lacking; cells all cylindrical or nearly so.........275

275a Branches scarce and short, or wanting altogether; if branches present, without repeated branching. See Fig. 158............ .... *RHIZOCLONIUM*

275b Branches many-celled, bearing secondary branches which arise irregularly so that the arbuscular habit is almost lost. See Fig. 192; wave-washed and winter form of........... *CLADOPHORA*

276a (257) Setae without cross walls at the base, formed by lateral extensions of cells just below the anterior cross parition of the cell. Fig. 194.. *FRIDAEA*

Figure 194

Fig. 194. *Fridaea torrenticola* Schmidle.

This is a very rare species (the only one known for the genus) but is quickly identified by the long, cylindrical cells which bear thread-like extensions that are given off laterally just below the anterior cross wall. The filaments occur in compact tufts and are usually yellowish-green in color.

276b Setae formed otherwise.................................277

277a Setae bulb-like at the base. Fig. 195............*BULBOCHAETE*

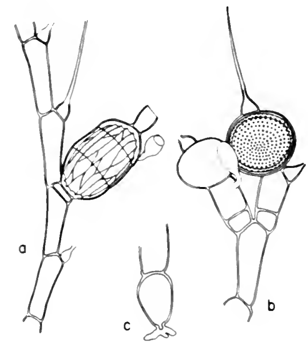

Figure 195

Fig. 195. a, *Bulbochaete insignis* Pringsh., showing oogonium with oospore, and an attached dwarf male plant; b, *B. congener* Hirn; c, holdfast cell.

Like its close relative, Oedogonium (Fig. 159) this genus contains numerous species which are differentiated on the basis of dimensions and details of the reproductive structures. They cannot be identified in the vegetative condition. The branched filaments are always attached (at least when young) and are quickly identified by the bulbous-based, unicellular setae that develop at the anterior end of the cell. They are to be sought on overhanging grass, or on the culms of rushes, submerged aquatic plants, etc. Most species have dwarf male plants growing epiphytically on the oogania (female sex organs).

277b Setae shaped otherwise....................................278

278a Setae sheathed at the base. See Fig. 150........*COLEOCHAETE*

278b Setae not sheathed at the base............................279

279a Thallus not embedded in mucilage, or if so, inclosed in a very soft watery mucilage without definite shape................280

279b Thallus inclosed in a firm mucilaginous matrix of definite shape, globular or somewhat elongate and irregularly arbuscular (sometimes strands 4-15 cm. in length). Fig. 196.....*CHAETOPHORA*

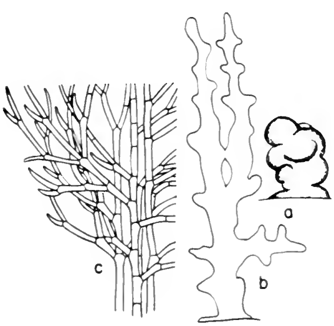

Figure 196

Fig. 196. a, *Chaetophora elegans* (Roth) C. A. Ag., habit of thallus; b, *C. incrassata* (Huds.) Hazen, habit of thallus; c, *C. incrassata*, portion of branching system.

Microscopically, species of this genus are delicately and gracefully branched filaments that occur in macroscopic tufts or gelatinous balls. One, *C. incrassata* (Huds.) Hazen, is composed of cables of elongate cells which give off laterally dense tufts of dichotomous branches. The resulting growth produces bush-like or arbuscular thalli which may become 10-15 centimeters in length. Other species form spherical or irregularly globose balls one or two millimeters in diameter on submerged leaves (especially in cold water), wood, or on cattail stems and are often gregarious so that extensive patches occur.

The firmness of the mucilage in which the plants are encased differentiates *Chaetophora* from its relatives *Draparnaldia* (Fig. 197) and *Stigeoclonium* (Fig. 177).

280a Thallus composed of slender, repeatedly branched filaments; cells all about the same size but tapering to fine points or hairs. See Fig. 177 .... *STIGEOCLONIUM*

280b Thallus consisting of an axis of large cells from which arise tufts of branches composed of smaller cells; tufts in whorls, opposite or alternate, occurring at rather regular intervals. Fig. 197.... .... *DRAPARNALDIA**

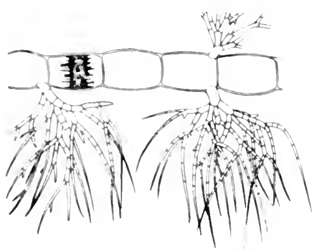

Figure 197

Fig. 197. *Draparnaldia glomerata* (Vauch.) Ag., showing tufts of lateral branches, with barrel-shaped axial cells containing band-like chloroplasts.

The genus is strikingly characterized by having a filament of large cells forming an axis from which tufted branches of smaller cells arise. Different species vary in size and shape of branching tufts. The thallus is inclosed in amorphous mucilage. Most species occur in cold water, often in shallow trickles or in springs. Macroscopically, they appear as pale green gelatinous strands that easily slip through the fingers.

281a (241) Parasitic in higher plants such as *Arisaema* (Indian turnip). See Fig. 92................................ *PHYLLOSIPHON*

281b Not parasitic...282

282a Filaments repeatedly dichotomously branched, regularly constricted at the base of the forkings. Fig. 198....*DICHOTOMOSIPHON*

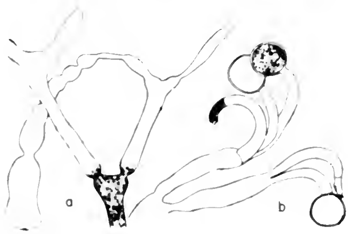

Figure 198

Fig. 198. *Dichotomosiphon tuberosus* (Braun) Ernst.

This species (the only one in the genus) occurs in dense, entangled tufts or mats, usually on the bottom of lakes, although occasionally on damp soil. There are downward growing, rhizoidal branches and upward directed vegetative and sex organ-producing branches. The oogonia when mature are so large that they can be easily seen with the naked eye. The plants seem to reproduce sexually only when growing in relatively shallow water (up to 4 feet) but may form extensive mats on the bottoms of lakes without fruiting in water up to 60 feet in depth.

**Draparnaldiopsis* is a rare genus resembling *Draparnaldia* but differs essentially by having long and short cells in the main axis (alternating). Tufts of branches are given off by the short cells only.

282b Filaments not dichotomously branched; without constrictions. Fig. 199 .... *VAUCHERIA*

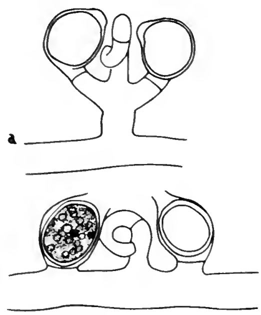

Figure 199

Fig. 199. a, *Vaucheria geminata* (Vauch.) De Cand., sex organs on a short pedicel; b, *V. sessilis* (Vauch.) De Cand.

Vaucheria usually forms dark green, velvety mats on damp soil,. on rocks in flowing water, or occasionally wooly mats floating at the surface of ponds, having broken away from their substrate. At maturity the growths are 'dirty' green in color. The siphonous filaments are large enough to be seen individually with the unaided eye. Several species are common in fresh water, differentiated by shape and position of the sex organs. The mats of *Vaucheria* harbor a veritable zoological garden of small animals. Long considered to be a member of the Chlorophyta, this genus is now classed with the Xanthophyceae in the Chrysophyta.

283a (5) Chromatophores violet, gray-green or bluish-green, often appearing brownish in mass; mostly macroscopic Rhodophyta..284

283b Chromatophores yellowish-green, carotin predominating, or some other color than above..290

284a Thallus macroscopic, spine-like, with node-like swellings, stiff and cartilaginous, very little if at all branched. Fig. 200...*LEMANEA*

Figure 200

Fig. 200. *Lemanea annulata* Kuetz., habit of plant.

This genus is a member of the Rhodophyta, but like other fresh water red algae it is some other color, being gray- or olive-green. The thalli are cartilaginous and stand erect from an attached base. The slender, spine-like growths (up to 20 cm. in length), devoid of branching make the plant easily recognizable. Species are differentiated mostly on details of the reproductive structures.

284b Thallus otherwise..285

285a Plant a uniseriate filament, branched or unbranched; (cells in 1 series); microscopic..289

285b Plant a multiseriate filament or thallus; microscopic.........286

286a Thallus embedded in soft mucilage; consisting of an axial filament with cortical (overlying) cells, bearing whorls of short and usually densely clustered branches; nodes and internodes evident. See Fig. 173......................*BRATRACHOSPERMUM*

286b Thallus otherwise..287

287a Thallus consisting of multiaxial filaments (strands of filaments) with numerous feathery branchings; without definite nodes and internodes. Fig. 201................................*THOREA*

Figure 201

Fig. 201. *Thorea ramossisima* Bory.

This is a feathery thallus macroscopically; microscopically composed of a multiaxial cable of filaments with short, compactly arranged out-turned branches. They may be as much as 50 cm. in length. It is of infrequent occurrence and sexual reproductive stages have not been found as yet.

287b Thallus otherwise..288

288a Thallus multiaxial (cables of filaments) with closely compacted and appressed cortical cells; thallus branching irregularly in a dichotomous fashion. Fig. 202 .... *TUOMEYA*

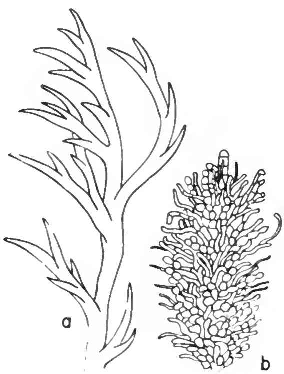

Figure 202

Fig. 202. *Tuomeya fluviatilis* Harvey. a, habit of thallus; b, apical portion of branch.

This rather rigid and cartilaginous member of the Rhodophyta is identified by the complex dichotomous or antler-like habit of branching of the thallus which is composed of multiaxial series of filaments and corticating cells. There is but 1 species.

288b Thallus including a monaxial filament which is inclosed and surrounded by compactly arranged and appressed, polygonal cortical cells which form just behind the apex. Fig. 203 .... *COMPSOPOGON*

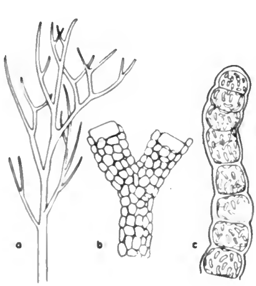

Figure 203

Fig. 203. *Compsopogon* sp., a, habit of thallus; b, portion of axis showing corticating cells; c, apical portion of uncorticated branch showing chromatophores.

This is a member of the Rhodophyta which seldom occurs in entirely fresh water but is frequently found in brackish situations, attached to various substrates, but especially to submerged stems of woody plants such as mangrove. *C. coeruleus* (Balb.) Mont. is the most common species. Although essentially filamentous, the thallus is macroscopic in proportions and appears as a rather delicately branched, tufted or bushy growth, blue- or gray- to violet-green in color. It is a tropical and subtropical genus but has been found occasionally in temperate latitudes.

289a (285) Filaments attached, uniseriate, branched. Fig. 204........ ....*AUDOUINELLA*

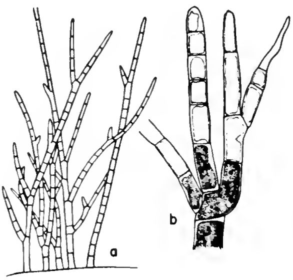

Figure 204

Fig. 204. *Audouinella violacea* (Kuetz.) Hamel. a, habit of thallus; b, branches in detail.

A member of the Rhodophyta, this species is nevertheless violet or gray-green. The loosely branched filaments are microscopic but may appear in tufts of macroscopic proportions. The main axial cells have disc-like or short ribbon-like chromatophores. In size, form, and habit of growth plants are easily mistaken for juvenile stages of *Batrachosperum* and if that genus is present in the habitat it could be assumed that *Audouinella*-like plants to be immature or so-called "Chantransia-stages" of *Batrachospermum* rather than *Audouinella*. There is but 1 species clearly defined in this country in fresh water and there is a disposition on the part of some authorities to classify it under the genus *Acrochaetium* which is mostly marine.

289b Filaments attached, uniseriate, unbranched. Fig. 205...*BANGIA*

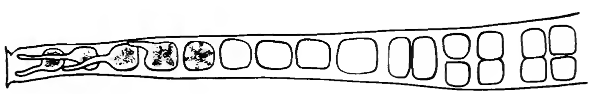

Figure 205

Fig. 205. *Bangia fuscopurpurea* (Dillw.) Lyngb., basal portion of filament.

This is a simple, unbranched member of the Rhodophyta, greenish-red or purplish in color. Filaments occur in tufts, sometimes dense, attached to submerged stones and wood. Although most species of the genus occur in salt water, this one is known from brackish or even nearly fresh-water habitats. It may be expected in estuaries.

290a (283) Chromatophores yellow, yellow-brown, or dark golden-brown, rarely blue; plants motile or non-motile......................341

290b Chromatophores not yellow-brown or golden-brown..........291

291a Chromatophores pale yellow-green with xanthophyll predominating; iodine test for starch negative; cell contents often showing a metallic lustre. Phylum Chrysophyta. (This group of algae is often difficult of determination on the basis of color of the chromatophore alone inasmuch as the shades of green cannot be clearly distinguished from those of the Chlorophyta. In addition to the iodine test for starch (which ordinarily is confirmative) heating plants in concentrated sulphuric acid (when the specimens lend themselves to such treatment) provides a helpful differentiation. The yellow-green algae (Heterokontae or Xanthophyceae) become blue-green in the acid whereas Chlorophyta remain unchanged in color) 300

291b Chromatophores not yellow-green 292

292a Cells with blue protoplasts or chromatophores 293

292b Cells with protoplasts or chromatophores not blue 295

293a One to four spherical or oval cells in a mucilaginous sheath which bears a gelatinous bristle. Fig. 206 .... ***GLOEOCHAETE***

Fig. 206. *Gloeochaete Wittrockiana* Lag.

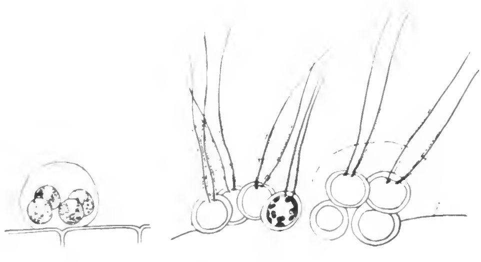

Figure 206

This is an anomalous organism, the morphology and physiology of which is interpreted as one of symbiotism involving a colorless member of the *Tetraspora* family (Figs. 35, 48) and a blue-green or cyanophyceous endophyte. The protoplast is a parietal cup similar to the chloroplast of many of the green algae. The long, slender gelatinous hairs make this species easy of identification. Cells occur in clumps (rarely solitary) attached to filamentous algae.

293b Plants not as above; sheaths present or absent although cells may be inclosed by old mother cell wall 294

294a A linear series of globular or oblong cells within a gelatinous matrix, chromatophores star-shaped. Fig. 207...*ASTEROCYSTIS*

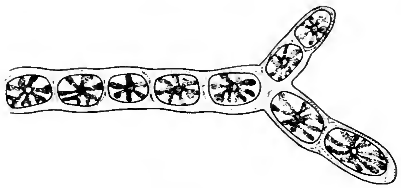

Figure 207

Fig. 207. *Asterocystis smaragdina* (Reinsch) Forti.

The bright blue-green, star-shaped chromatophores of this species (the globose or oval cells being enclosed in a wide gelatinous sheath) help to identify this branched filamentous alga. It is a member of the Rhodophyta; usually occurs as an epiphyte on larger filamentous algae but may appear in mixtures of free-floating forms.

294b Two to four, or eight globose or oval cells contained within an enlarged mother-cell wall; chromatophore-like bodies vermiform (few and long, or many and short). Fig. 208....*GLAUCOCYSTIS*

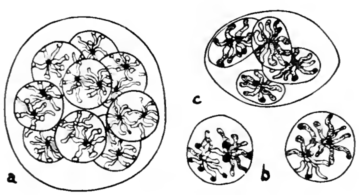

Figure 208

Fig. 208. a, b, *Glaucocystis duplex* Presc.; c, *G. Nostochinearum* Itz.

There are apparently 2 or 3 species of this genus which like *Gloeochaete* (Fig. 206) involve an endophytic blue-green alga and a colorless member of the Oocystaceae (Fig. 85). The protoplasts are bright blue-green and occur in different shapes and arrangements within either globose or oval cells, according to species. The plants are free-floating in the tychoplankton near shore or in shallow water habitats of swamps and bogs.

295a (292) Cells in compact, irregularly shaped colonies, appearing brown or orange-colored because of dark mucilage. See Fig. 49 ....*BOTRYOCOCCUS*

295b Cells not in opaque or orange-colored colonies as above; contents red, violet-red, or green with a red tinge..................296

296a Living in snow in alpine regions (red snow). See Fig. 57........ ....*CHLAMYDOMONAS*

296b Not living in snow...297

297a A colony of oval or globose cells inclosed in a layered sheath. See Fig. 41...............................*GLOEOCYSTIS*

297b Cells not in colonies; sheath not layered.................298

298a Cells spherical, solitary or gregarious, terrestrial, forming dark red patches on damp soil (common in green houses). Fig. 209. .... *PORPHYRIDIUM*

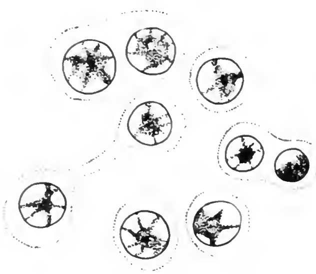

Fig. 209. *Porphyridium cruentum* Naeg.

On the damp soil of green houses or on wet brick walks this plant often forms purple, or wine-red gelatinous films. It is a unicellular member of the Rhodophyta which has a star-shaped chromatophore.

Figure 209

298b Cells round, ellipsoid, or fusiform, not arranged as above....299

299a Cells fusiform; haematochrome coloring the green cell red; with 1 flagellum. See Fig. 8............................ *EUGLENA*

299b Cells round or ellipsoid; protoplast with a wide wall which appears as a gelatinous sheath; flagella 2, but usually not showing when cells are in an encysted condition at which time they exhibit a red color. See Fig. 19.............. *HAEMATOCOCCUS*

300a (291) Plants filamentous....................................301

300b Plants not filamentous....................................304

301a A false filament, consisting of branched tubes with 1 or 2 spherical cells at the distal ends. Fig. 210.............. *MISCHOCOCCUS*

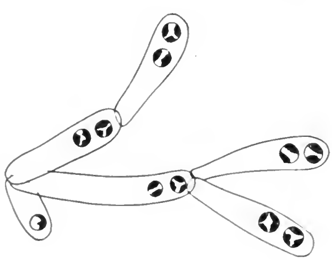

Fig. 210. *Mischococcus confervicola* Naeg.

The globose, yellowish-green cells of this species occur at the ends of repeatedly branched gelatinous stalks, attached to filamentous algae. Only 1 species is known from this country.

Figure 210

301b Plant a true filament....................................302

302a Filament branched. Fig. 211 . . . . ***MONOCILIA***

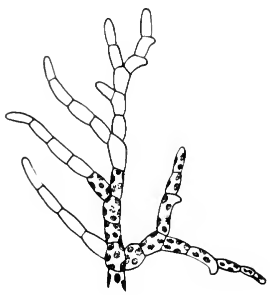

Figure 211

Fig. 211. *Monocilia viridis* Gerneck.

This and another species, *M. flavescens* Gerneck, are the only ones reported from this country, the former being more common. It occurs as an irregularly and indefinitely branched filament in soil. A member of the Chrysophyta, the disc-like chromatophores are yellow-green or yellow in color, and the food reserve is in the form of oil; starch test negative.

302b Filament not branched 303

303a Cells long-cylindrical; wall of cells formed of 2 pieces which overlap at the midregion, the overlapping usually evident when empty cells are viewed; filaments showing H-shaped pieces upon fragmenting; cells often with lateral walls convex. Fig. 212 . . . . ***TRIBONEMA***

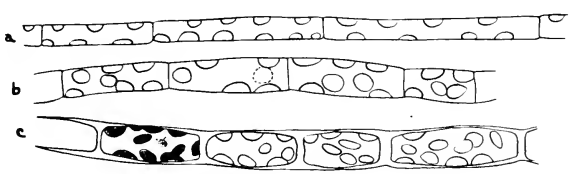

Figure 212

Fig. 212. a, *Tribonema bombycinum* var. *tenue* Hazen; b, *T. bombycinum* (Ag.) Derbes & Solier; c, *T. utriculosum* (Kuetz.) Hazen.

There are 3 or 4 species of this simple, unbranched filamentous member of the Chrysophyta, differentiated by proportions of the cell and number and shape of the chromatophores. Like *Microspora* (Fig. 172) in the Chlorophyta, the cell walls are composed of 2 sections which adjoin and overlap in the midregion of the cell. Hence when the filaments fragment the typical H-shaped sections are seen. By careful focusing the overlapping of the wall sections can be seen in the unfragmented portions of the filament, especially in some species which have a relatively thick wall. The chromatophores are pale-green or yellowish and occur as parietal discs.

303b Cells short-cylindric or quadrate; overlapping of wall sections not apparent but visible at the end of broken filaments; lateral margins of cells strictly parallel. Fig. 213..............*BUMILLERIA*

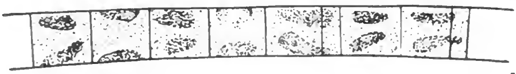

Figure 213

Fig. 213. *Bumilleria sicula* Borzi.

There are 2 species known from the country, *B. exilis* Klebs being much smaller (6 μ in diameter) than the one figured. The unbranched filaments are similar to *Tribonema* (Fig. 212) but the cells are more nearly rectangular in optical section, with parallel lateral walls. Sometimes external overlapping H-shaped sections of thicker wall layers, brownish in color, occur intermittently along the filament.

304a (300) Plant a small (1-2 mm. diam.) green vesicle, balloon-shaped; terrestrial. Fig. 214..............................*BOTRYDIUM*

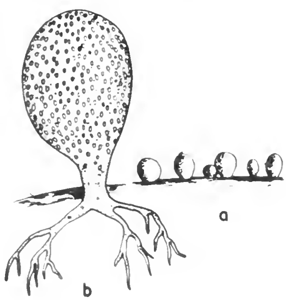

Figure 214

Fig. 214. *Botrydium granulatum* (L.) Grev.

On damp soil under green house benches or on mud of lakes where water has receded tiny green, balloon-like growths appear. These are siphonaceous members of the Chrysophyta which have underground rhizoidal branches in which resting spores may be found. Plants can be seen with the unaided eye or are easily detected with a hand lens. Although dark green in color the plant has other characters which relate it to the yellow-green algae, such as the absence of starch and the possession of zoospores with flagella of unequal length. There is another species, *B. Wallrothii* Kuetz., which has a thick, wrinkled, lamellate wall.

304b Plant not a green vesicle; aquatic........................305

305a Cells solitary or incidentally clustered......................306

305b Cells in colonies, definite or indefinite in shape and arrangement; sometimes forming stalked colonies..................333

306a Cells attached, sessile, or on a stalk......................307

306b Cells free-floating or swimming............................314

307a Cells sessile...308

307b Cells on a short or long stalk............................310

308a Cell membrane in 2 sections, the upper lifting off at maturity to allow escape of aplanospores (small globular spores); cells oval or short-cylindric. Fig. 215. . . . .*CHLOROTHECIUM*

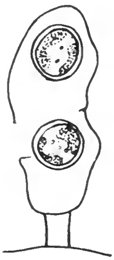

Figure 215

Fig. 215. *Chlorothecium Pirottae* Borzi.

This cylindrical plant with parietal yellow-green chromatophores is attached by a short stalk and a disc to submerged plants, including larger algae. It is rather rare (only one species reported from this country) and is easily overlooked because it occurs in the dense mixture of algae from bogs.

308b Cell membrane not in 2 sections. 309

309a Cells globose or subglobose; cytoplasm reticulate. Fig. 216. . . . .*PERONE*

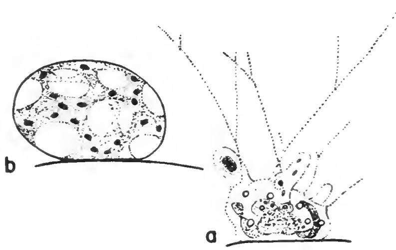

Figure 216

Fig. 216. *Perone dimorpha* Pascher. a, rhizoidal stage; b, vegetative cell.

There is a freely moving amoeboid stage and an attached or endophytic encysted stage in the life history of this plant. In the resting stage the cell is to be found in *Sphagnum* or other moss leaves, with a highly recticulated, faintly pigmented protoplast.

309b Cells shaped otherwise; cytoplasm not highly recticulated nor alveolar. Fig. 217. . . . .*CHARACIOPSIS*

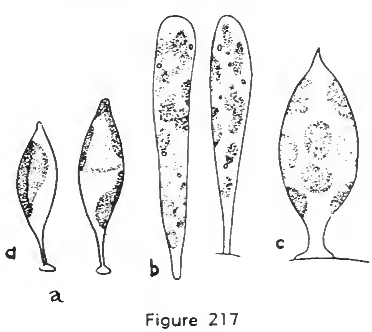

Figure 217

Fig. 217. a, *Characiopsis acuta* (Braun) Borzi; b, *C. cylindrica* (Lambert) Lemm.; c, *C. spinifer* Printz.

There are several fairly common species of this genus which occur as epiphytes on filamentous algae. They vary in shape and in length of attaching stalk. Unlike the genus *Characium* (Fig. 87), some species of which are very similar in shape, no starch is formed and the chromatophore is pale green or yellowish-green. The starch-iodide

test must be used to differentiate the two genera. *Characiopsis* often shows one to several spherical droplets of oil (?) or other food reserve in the cytoplasm which are not present in *Characium*.

310a (307) Cells with a vase-like, pitcher-shaped or globose lorica (envelope) with a neck and a terminal opening. Fig. 218........ ....*STIPITOCOCCUS*

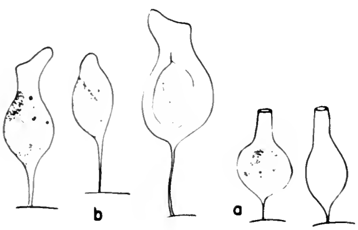

Figure 218

Fig. 218. a, *Stipitococcus vasiformis* Tiffany; b, *S. urceolatus* West & West.

There are 3 or 4 species of this genus of rather uncommon occurrence, although in particular habitats the various species are relatively abundant and filamentous algae may be densely overgrown with the epiphytes. *S. urceolatus* West & West is perhaps more frequently seen than others and is easily identified because of its distinctive, pitcher-shaped lorica.

310b Cells without a lorica....................................311

311a Cells cylindrical, straight or curved, sometimes with a spine at one or both ends. Fig. 219....................*OPHIOCYTIUM*

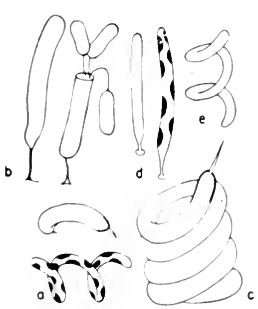

Figure 219

Fig. 219. a, e, *Ophiocytium parvulum* (Perty) Braun; b, *O. gracilipes* (Braun) Rab.; c, *O. cochleare* (Eichw.) Braun; d, *O. desertum* var. *minor* Presc.

The factors which determine the distribution of this genus are unknown, but there seems to be good evidence that water chemistry determines the presence of these species, of which there are several reported for the United States. Where one species is found, several others also occur as well as many other genera of the Xanthophyceae, a class of the Chrysophyta to which this genus belongs. Species are differentiated by presence or absence of polar spines, and whether free-floating or stalked and epiphytic. They usually occur intermingled with miscellaneous algae from the shallow water of swamps and bogs, occasionally appear in the euplankton of lakes. Most species are solitary but attached forms may be incidentally colonial.

311b Cells shaped differently 312

312a Cells club-shaped or somewhat pear-shaped; walls in 2 sections, the upper lifting away to permit escape of spores. See Fig. 215. . . . . *CHLOROTHECIUM*

312b Cells spherical, fusiform, or ovoid; wall in 1 piece 313

313a Stipe slender, thread-like, longer than the cell body. Fig. 220. . . . . *PERONIELLA*

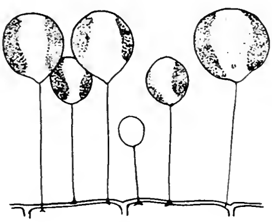

Figure 220

Fig. 220. *Peroniella Hyalothecae* Gobi.

Species of this genus occur solitarily or in gregarious clusters on other algae, or are attached in the mucilage of colonial forms. The species illustrated seems to occur no other place but on the filamentous desmid, *Hyalotheca*. Like other members of the Chrysophyta, the chromatophores are not a grass-green but a pale shade, and there are usually refractive globules of oil or some other kind of food reserve than starch.

313b Stipe stouter, shorter than the cell body in length (or rarely equalling it). See Fig. 217 . . . . *CHARACIOPSIS*

314a (306) With 2 flagella of unequal length. Fig. 221 . . . . *CHLOROCHROMONAS (OCHROMONAS)*

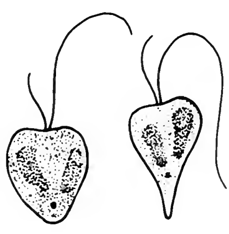

Figure 221

Fig. 221. *Chlorochromonas minuta* Lewis.

This rare species (probably referrable to *Ochromonas*) is variable in shape from truncately-oval to pear-shaped. Care must be used in detecting the two flagella of unequal length. Motile, pear-shaped cells in the microscope field, with yellowish chromatophores should be examined for flagella characters. Frequently the cells come to rest and attach themselves to a substrate at the posterior end. Only one species has been reported in the United States.

314b Without flagella 315

315a Cell wall smooth 316

315b Cell wall sculptured or decorated, sometimes spiny 325

316a Cells spherical, subglobose, or broadly ovate to subpyriform (pear-shaped) 317

316b Cells rectangular, cylindrical, or crescent-shaped 320

317a Cells contained in a gelatinous envelope. Fig. 222 . . . . ***CHLOROBOTRYS***

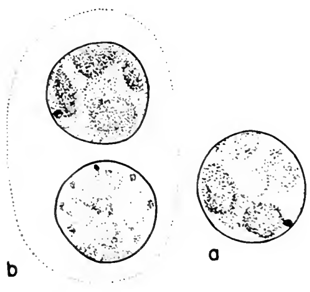

Figure 222

Fig. 222. *Chlorobotrys regularis* (West) Bohlin. a, single cell; b, two cells inclosed in common mucilage.

The identifying character of this species is the paired arrangement of the spherical cells inclosed in a mucilaginous sheath. There are several parietal chromatophores and a red spot which is an oil globule. Even though preserved, when some identifying characteristics are lost, the cells retain the dark-colored spot.

317b Cells not inclosed in a gelatinous envelope **318**

318a Cell wall in 2 sections, separating and persisting as membranous sections near the liberated autospores (small replicas of the parent cell). Fig. 223 . . . . ***DIACHROS***

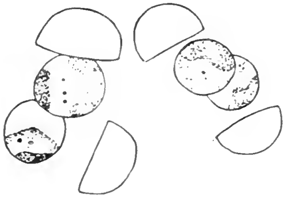

Figure 223

Fig. 223. *Diachros simplex* Pascher.

This is the only species reported from the United States. It is somewhat like *Schizochlamys* (Fig. 48) in the Chlorophyta in that the mother-cell wall fragments are retained after new cells (autospores) are released and these persist as hemispherical, transparent cups near the daughter cells.

318b Cell wall in 1 piece; mother-cell not forming persisting sections but degenerating to liberate spores **319**

319a Cells spherical. Fig. 224 .... *BOTRYDIOPSIS*

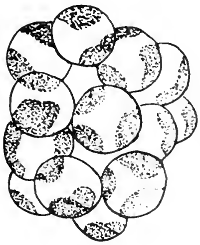

Figure 224

Fig. 224. *Botrydiopsis arhiza* Borzi.

In the same habitats where *Ophiocytium* (Fig. 219) occurs one may usually find this species; a solitary, free-floating cell which is either spherical or spheroidal. Small cells, when young, may contain but a single chromatophore, but in age develop many parietal, yellowish-green bodies. Another species, *B. eriensis* Snow, is larger and less commonly seen. Apparently it is a truly planktonic species whereas *B. arhiza* occurs in shallow water (tychoplankton).

319b Cells broadly ovoid or pear-shaped. Fig. 225........ *LEUVENIA*

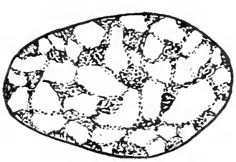

Figure 225

Fig. 225. *Leuvenia natans* Gardner. (Redrawn from Smith).

Although essentially unicellular, this species occurs in a dense film at the surface of a quiet pond. Young cells are spherical and have but 1 or 2 chromatophores, whereas older cells become pear-shaped or ovate, and have numerous yellow-green chromatophores. There is but 1 species in the genus and it seems to be rare, having been reported only from California in this country.

320a (316) Cells rectangular, with a spine at each corner. Fig. 226. .... *PSEUDOTETRAEDRON*

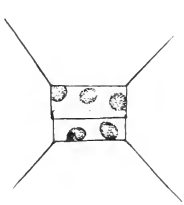

Figure 226

Fig. 226. *Pseudotetraedron neglectum* Pascher.

This rectangular cell with a spine at each corner clearly shows the chrysophycean character in its 2-parted wall, the sections overlapping in the midregion of the cell. This can be seen only when the cells are turned on their 'side' of course. In end view the cells are narowly elliptic. There are several yellow-green chromatophores and oil bodies as food reserve. The only species has been reported but rarely from the United States.

320b Cells cylindrical or crescent-shaped........................321

321a Cells elongate-cylindric, coiled or S-shaped, equally rounded at both poles. See Fig. 219......................*OPHIOCYTIUM*

321b Cells oblong, sides convex, short-cylindric, or fusiform, sometimes not equally rounded at both poles; curved but not coiled, nor twisted...322

322a Cells short-cylindric, 1½-2 times as long as broad; poles symmetrically rounded. Fig. 227..................*MONALLANTUS*

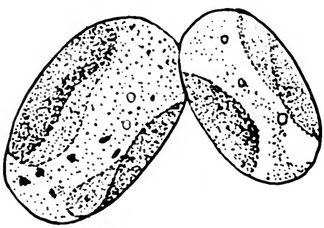

Figure 227

Fig. 227. *Monallantus brevicylindrus* Pascher.

This is the only species reported from the United States. It occurs in the same habitats with *Ophiocytium* (Fig. 219) and *Bumilleriopsis* (Fig. 228).

322b Cells fusiform or cylindric only in part; poles unsymmetrical...323

323a Cells fusiform or sickle-shaped..........................324

323b Cells irregularly cylindrical; poles unsymmetrical. Fig. 228..... ....*BUMILLERIOPSIS*

Figure 228

Fig. 228. *Bumilleriopsis brevis* Pascher.

These cells have yellow-green chromatophores and occur singly or in clusters which are definitely colonial. The irregularly curved cylinders (rarely somewhat fusiform) with the poles of the cells unlike one another in shape, help in identification.

324a Cells broadly fusiform, abruptly narrowed at the poles. Fig. 229. .... *PLEUROGASTER*

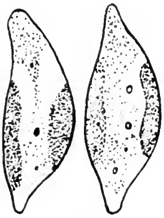

Figure 229

Fig. 229. *Pleurogaster lunaris* Pascher.

The chief difference between this genus and *Bumilleriopsis* (Fig. 228) is the definitely fusiform shape, the poles of the cells symmetrical. There are 2 species, differentiated by size and variation in shape, reported from the United States, but like many of the genera of Chrysophyta, they are rare and never occur in pure growths as do so many of the Chlorophyta and Cyanophyta.

324b Cells narrowly fusiform, spindle-shaped or sickle-shaped. Fig. 230 .... *CHLOROCLOSTER*

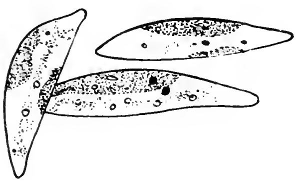

Figure 230

Fig. 230. *Chlorocloster pyreniger* Pascher.

In this genus the cells are narrowly spindle-shaped and usually are distinctly curved or even sickle-shaped. They are found intermingled sparingly among algal mixtures from shallow water of open bogs, and apparently only where the water is acid. Only 1 species has been reported from the United States.

325a (315) Cells elongate-cylindric, with a spine at one or both poles.326

325b Cells short-cylindric, spherical or angular..................327

326a Cells nearly straight or only slightly bent. Fig. 231............ .... *CENTRITRACTUS*

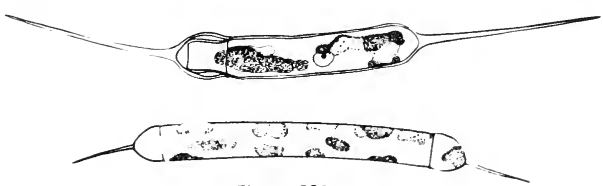

Figure 231

Fig. 231. *Centritractus belanophorus* Lemm., showing wall in 2 sections.

There are 3 species of the genus reported from the United States, differentiated by size, proportions, and shape of cell. Whereas some are very short, and elliptic when young, others are very long indeed, and straight or slightly curved. It is the straight form that can be used to separate this genus from *Ophiocytium* (Fig. 219) some species of which it resembles in respect to the overlapping sections of the wall, color of chromatophores, etc.

326b Cells coiled, S-shaped, or hooked at one end. See Fig. 219. . . . . *OPHIOCYTIUM*

327a (325) Cells spherical 328

327b Cells some other shape 329

328a Cell wall serrate at the margins, the surface of the cell showing broad depressions (sometimes faintly seen). Fig. 232. . . . . *ARACHNOCHLORIS*

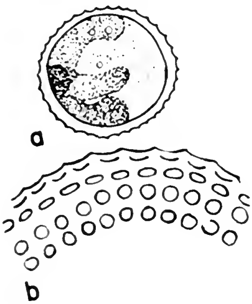

Figure 232

Fig. 232. *Arachnochloris minor* Pascher. a, cell showing chromatophores; b, sample of wall showing circular, thin areas.

These round cells show the characteristic depressions of the wall at the margin where it appears that the cell is covered with short, sharp spines. These are the tops of ridges formed by slight depressions in the wall that sometimes scarcely can be seen when the cell is viewed in the center. There is but 1 species reported from the United States.

328b Cell wall bearing curved or straight spines. Fig. 233. . . . . *MERINGOSPHAERA*

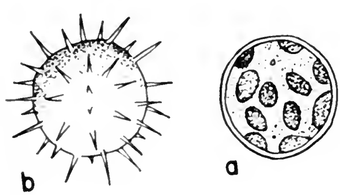

Figure 233

Fig. 233. *Meringosphaera spinosa* Presc. a, optical section of cell showing chromatophores; b, exterior of cell showing spines on wall.

In this genus the wall bears long, or short spines or cylindrical, thread-like outgrowths. *M. spinosa* Presc. questionably has been assigned to this genus from freshwater ponds in this country, although the genus is marine.

329a (327) Cells broadly fusiform or subtriangular, narrowed abruptly at one or both poles to form spine-like projections. See Fig. 229. . . . . *PLEUROGASTER*

329b Cells with other shapes 330

330a Cells oblong to subcylindric; surface of wall with rows of depressions. Fig. 234 .... *CHLORALLANTUS*

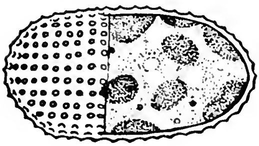
Figure 234

Fig. 234. *Chlorallantus oblongus* Pascher, represented with portion of wall removed to show chromatophores.

The very regular rows of depressions (forming teeth at the cell margin) help in the identification of this species. The cells are capsule-like in shape and are found scattered about among other algae from open bogs. Only 1 species has been reported from the United States.

330b Cells with other shapes 331

331a Cells oval or biconvex. Fig. 235 .... *TRACHYCHLORON*

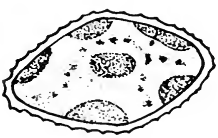
Figure 235

Fig. 235. *Trachychloron biconicum* Pascher.

Cells of this genus, like *Chlorallantus* (Fig. 234), have depressions in the wall. They are broadly elliptic or oval or fusiform in shape and contain a gracefully curved chromatophore. But one species has been reported from this country.

331b Cells triangular, pyramidal, or tetragonal 332

332a Cells pyramidal or tetragonal. Fig. 236 .... *TETRAGONIELLA*

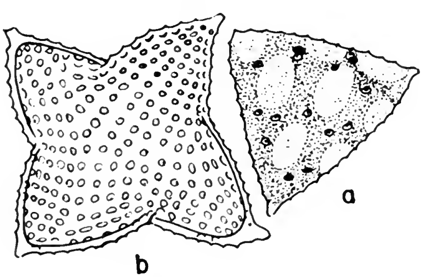

Figure 236

Fig. 236. *Tetragoniella gigas* Pascher. a, optical section showing chromatophores and reticular nature of the protoplast; b, exterior of cell showing scrobiculate wall.

The cells in this genus are beautifully sculptured by regularly arranged rows of depressions. According to position the cells show different shapes, triangular or tetragonal. One species is reported from mixtures of algae taken from open bogs.

332b Cells flattened, appearing triangular in face view; fusiform in side view. Fig. 237 . . . . *GONIOCHLORIS*

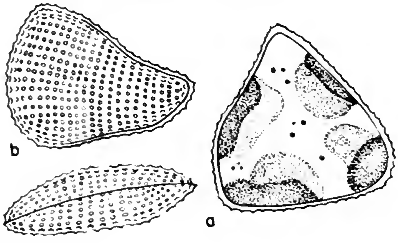

Figure 237

Fig. 237. *Goniochloris sculpta* Geitler. a, optical section showing chromatophores; b, exterior 'front' view, but flattened and narrowly elliptic when seen from the 'side'; c, in the lateral view the overlapping of the 2 wall sections sometimes can be detected. There are 4 or 5 curved, plate-like chromatophores. One species only has been reported from the United States.

333a (305) Cells attached by a stipe 334

333b Cells without a stipe 335

334a In a globular lorica (envelope) which has an anterior opening. See Fig. 220 . . . . *PERONIELLA*

334b Not in a lorica. See Fig. 219 . . . . *OPHIOCYTIUM*

335a (333) With a mucilaginous sheath 336

335b Without a sheath 339

336a Cells numerous, oval, in a globular macroscopic, free-floating colony. Fig. 238 . . . . *CHLOROSACCUS*

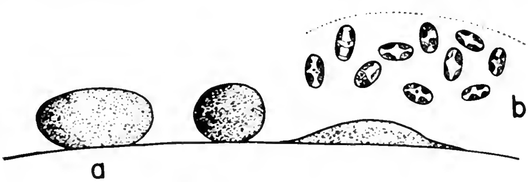

Figure 238

Fig. 238. *Chlorosaccus fluidus* Luther (*Gloeochloris Smithiana* Pascher). a, diagram of colony shapes; b, cells in mucilage.

This rare species occurs as macroscopic gelatinous balls (up to 20 mm. in diameter) on the stems of submerged plants (including *Chara*); occasionally may be found free-floating. The colony is composed of irregularly arranged oval cells containing from 2 to 6 parietal chromatophores (yellow-green). There is but one species.

336b Cells shaped or arranged otherwise 337

337a Cells solitary or in pairs at the ends of branched gelatinous tubes. See Fig. 210 . . . . *MISCHOCOCCUS*

337b Cells arranged otherwise 338

338a Cells spherical, 2 within a globular envelope. See Fig. 222 .... *CHLOROBOTRYS*

338b Cells spherical, many within a gelatinous matrix. Fig. 239 .... *GLOEOBOTRYS*

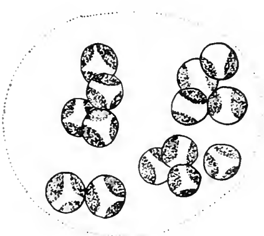

Figure 239

Fig. 239. *Gloeobotrys limneticus* (G. M. Smith) Pascher.

The chief difference between this genus and *Chlorobotrys* (Fig. 222) is the presence of a definite mucilaginous sheath about the cells to form colonies. The species illustrated at one time was assigned to *Chlorobotrys;* described from the open water plankton of lakes.

339a (335) Cells forming loose cushions, in multiples of 2 or 4. Fig. 240. .... *CHLORELLIDIOPSIS*

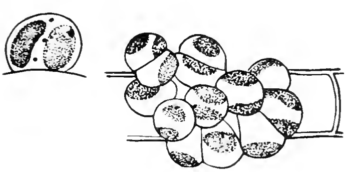

Figure 240

Fig. 240. *Chlorellidiopsis separalibis* Pascher.

Although cells of this species are sometimes solitary they usually occur in closely grouped clusters on the walls of other algae. There are 2 parietal chromatophores and at least 1 dark red oil-spot in the mature cells. Only 1 species reported from this country.

339b Cells arranged otherwise 340

340a Wall in 2 sections which separate to liberate spores (new cells) and which persist nearby; (cells may be incidentally colonial because of gregarious habit). See Fig. 223 .... *DIACHROS*

340b Wall in 1 piece, breaking down irregularly to liberate spores; (cells incidentally clustered to form colonies). See Fig. 224 .... *BOTRYDIOPSIS*

341a (290) Plant a branched, feathery, gelatinous thallus, the protoplasts crowded in linear series with tough, tublular envelopes. Fig. 241 .... *HYDRURUS*

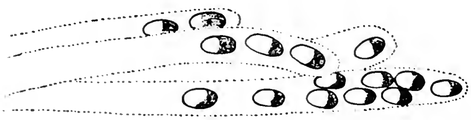

Figure 241

Fig. 241. *Hydrurus foetidus* (Vill.) Trev. Cells in mucilaginous tubes.

Usually in high mountain streams, this organism forms stringy, brown, gelatinous masses attached to stones. The bushy, yellow-green or brown tufts contain oval cells arranged in linear series within gelatinous tube-like strands. Sometimes a small stream will be actually choked with the dense growths. The disagreeable odor these plants have is responsible for the specific name. The cells may change into rather curiously shaped, pyramidal zoospores that have but one flagellum.

341b Plant not a feathery, gelatinous thallus....................342

342a Sparsely branched, sedentary filaments. Fig. 242.............. ....*PHAEOTHAMNION*

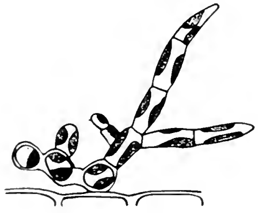

Figure 242

Fig. 242. *Phaeothamnion confervicola* Lag.

This member of the Chrysophyceae is the only genus in which there is a branched filament. The branches scarcely taper at the ends. The plants are relatively small and grow on the walls of larger filamentous algae. Each cell has a parietal, ochre-green to brownish chromatophore.

342b Not a branched filament.................................343

343a A colony of vase-shaped cones (loricas), 1 or 2 cones arising from within the mouth of another and forming forked series. Fig. 243. .... *DINOBRYON*

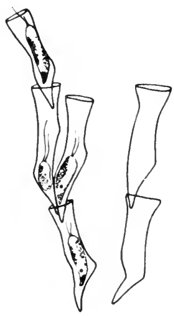

Figure 243

Fig. 243. *Dinobryon sertularia* Ehr.

There are several species of this genus, all of which are characterized by having the motile protoplasts inclosed within colorless envelopes. The envelopes are usually contained 1 or 2 within another so that branching chains are formed. Some species occur as solitary cells, however. The genus is one which inhabits mostly hard water lakes in the euplankton; sometimes are very abundant and produce disagreeable odors and tastes in reservoirs.

343b Cells solitary or arranged otherwise........................344

344a A unicell, consisting of a yellowish protoplast contained in a vase-shaped envelope. See Fig. 243..................*DINOBRYON*

344b Cells shaped otherwise, solitary or colonial.................345

345a Cells solitary, colonial or filamentous; wall silicious and etched with grooves or rows of dots which form definite patterns; wall in 2 sections. 1 part forming a lid over a slightly smaller one; oil drops usually conspicuous; solitary cells often showing a gliding or jerky movement. DIATOMS. Fig. 243½........................450

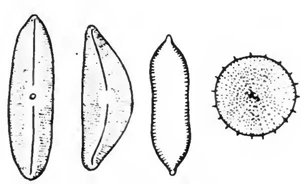

Figure 243½

345b Cells without silicious walls, so decorated; oil droplets lacking or inconspicuous, not showing gliding movements; if motile, equipped with flagella or moving by pseudopodia (amaeboid fashion)..346

346a Unicellular, with flagella but usually not swimming.........347

346b Multicellular or colonial; motile or non-motile..............365

347a Cell within a variously shaped envelope (lorica), with a flagellum opening....................................348

347b Cell without such an envelope..............................352

348a Envelope cone-shaped, narrowed posteriorly to a blunt or sharp point 349

348b Envelope flask-shaped, globose or pyramidal................350

349a Envelope with smooth or slightly wavy margins; without transverse growth rings. See Fig. 243..................*DINOBRYON*

349b Envelope with marginal, bristle-like projections caused by transverse growth rings. Fig. 244....................*HYALOBRYON*

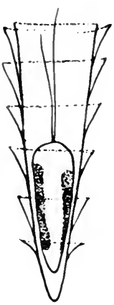

Figure 244

Fig. 244. *Hyalobryon mucicola* (Lemm.) Pascher.

This species is solitary and the envelope has margins which have bristles which represent the remains of the envelopes of previous generations of cells. Whereas *Dinobryon* (Fig. 243) is freely swimming, this genus is solitary or colonial as an epiphyte on filamentous algae.

350a (348) Cells free-swimming; envelope globose, with long spines; flagellum collar narrow. Fig. 245.............*CHRYSOSTRELLA*

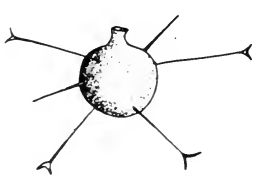

Figure 245

Fig. 245. *Chrysostrella paradoxa* Chod.

This is the only species reported from this country, occurring either in open water plankton or intermingled among mixtures of algae near shore. The test or envelope bears a few long needle-like setae which are often forked at the tips. The round or oval cells with a short collar around the flagellum aperture make this organism easy of identification.

350b Cells attached, usually not globose; without spines..........351

351a Envelope vase-shaped; transversely oval or pyramidal with base next to the substrate. Fig. 246.....................*LAGYNION*

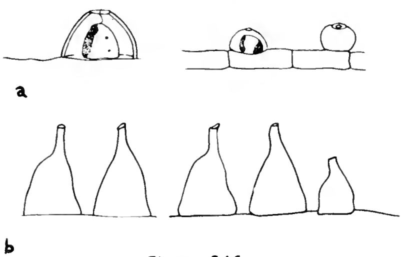

Figure 246

Fig. 246. a, *Lagynion reductum* Presc.; b, *L. triangularis* var. *pyramidatum* Presc.

There are 3 or 4 species of this genus which may be overlooked in algal collections because they are relatively small, often nearly transparent, growing on the walls of filamentous algae. The cells are vase-shaped (triangular in optical section), but this varies somewhat according to species. The protoplast contains a faintly pigmented, yellowish chromatophore.

351b Envelope narrowed in the posterior portion. Fig. 247........... ....*DEREPYXIS*

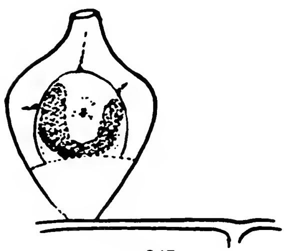

Figure 247

Fig. 247. *Derepyxis dispar* (Stokes) Senn.

The chief difference between this genus and *Lagynion* (Fig. 246) is the presence of a supporting membrane through the lorica upon which the protoplast is suspended. This is the only species reported from this country, occurring as a minute epiphyte on filamentous algae.

352a (347) Cells swimming by 1 flagellum; wall impregnated with variously shaped silicious scales (appearing like chain armor) which bear bristles or needles. Fig. 248...............*MALLOMONAS*

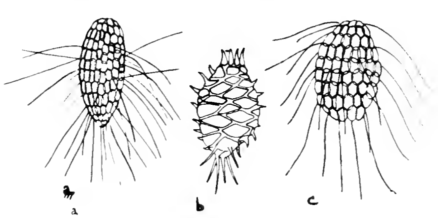

Figure 248

Fig. 248. a, *Mallomonas caudata* Iwanoff; b, *M. pseudocoronata* Presc.; c, *M. acaroides* Perty.

These species occur in the open water plankton of mostly hard water lakes, frequently in abundance. They are differentiated one from the other by the shape and arrangement of the scales in the membrane and in the arrangement of the bristles. They often occur in lakes in which there is a high degree of pollution. Although motile, the single flagellum is hardly distinguishable unless the cells are recently collected and viewed under very favorable optical conditions.

352b Cells either not motile, or moving by pseudopodia (amoeboid fashion), or by 2 flagella; wall without scales and needles....353

353a Cells amoeboid; protoplast very pale yellow-green or yellow-brown 354

353b Cells swimming by 2 flagella, or sedentary; protoplast deeply pigmented, usually a golden brown or blue.................355

354a Pseudopodia long and needle-like. Fig. 249.....*RHIZOCHRYSIS*

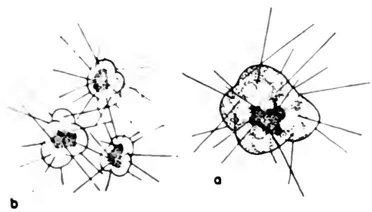

Figure 249

Fig. 249. *Rhizochrysis limnetica* G. M. Smith. a, single cell; b, cells in temporary colonial arrangement.

This is the only species of the genus reported in the United States. The amoeboid member of the Chrysophyta has long, slender needle-like pseudopodia. Cells are ordinarily solitary but may occur in loose, temporarily united colonies.

354b Pseudopodia short, tapering from the base to a fine point. Fig. 250 ....*CHRYSAMOEBA*

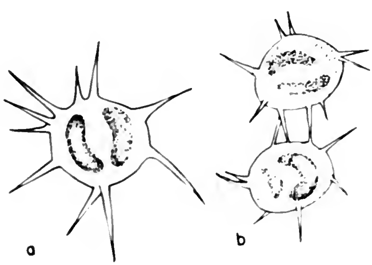

Figure 250

Fig. 250. *Chrysamoeba radians* Klebs. a, single cell; b, temporarily adjoined cells.

This species, the only one reported, occurs more commonly than *Rhizochrysis* (Fig. 249). Usually the cells occur in an amoeboid condition, bearing short, sharply pointed pseudopodia, but may change to a condition in which a single flagellum is present as a locomotory organ.

355a (353) Cells attached..................................356

355b Cells floating free, or swimming.........................357

356a Cells inversely triangular, or tetrahedral in top view, angles tipped with 1 or 2 spines. Fig. 251 .... *TETRADINIUM*

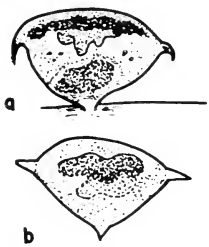

Figure 251

Fig. 251. *Tetradinium simplex* Presc. a, side view; b, vertical view.

The chromatophores of this sessile member of the dinoflagellates are typically brown. The four corners of the cell are tipped with 2 short spines. This and 1 other species, *T. javanicum* Klebs, have been reported as epiphytes on filamentous algae. It should be compared with *Raciborskia* (Fig. 252) in making determinations.

356b Cells inversely triangular, elliptic in top view, the outer free angles tipped with 1 stout spine. Fig. 252 .... *RACIBORSKIA*

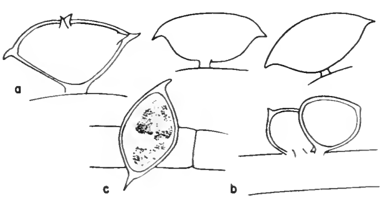

Figure 252

Fig. 252. *Raciborskia bicornis* Wolosz. a, side view, showing stipe; b, top and lateral view.

These are elliptical cells, sessile on a short stalk and attached to filamentous algae or aquatic mosses. There is a single spine at each pole of the cell. One species only has been reported from the United States. Compare with *Tetradinium* (Fig. 252) in making determinations.

357a (355) Cells crescent-shaped, the horns extended to form a spine-like tip which is recurved in most species. Fig. 253 .... *CYSTODINIUM*

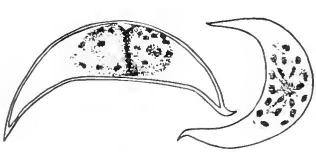

Figure 253

Fig. 253. *Cystodinium cornifax* (Schiller) Klebs.

This and 2 or 3 other species occur as free-floating members of the encysted type of dinoflagellates. They are differentiated on the basis of variations of the crescent-shaped cells, with the horns twisted at various angles. Several species of *Tetraedron* (Fig. 131) have been incorrectly described from members of this genus.

357b Cells not crescent-shaped 358

358a Cells broadly oval, ovate, or obovate, with a truncate or bilobed anterior end; flagella 2, attached at the anterior end; chromatophores 2, lateral elongate plates....................................359

358b Cells shaped otherwise; flagella not anterior................360

359a Cells without a gullet in the anterior end, but with a slight apical depression. Fig. 254..........................*CHROOMONAS*

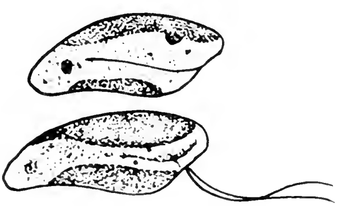

Figure 254

Fig. 254. *Chroomonas Nordstedtii* Hansg.

These minute, slipper-shaped organisms have 2 parietal, blue chromatophores, and 2 flagella that are attached just below the apex of the cell. They move rapidly and determinations cannot be made unless some medium is introduced to the mount to slow down their action. Use 5% glycerin.

359b Cells with a gullet. Fig. 255..................*CRYPTOMONAS*

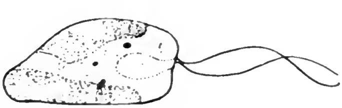

Figure 255

Fig. 255. *Cryptomonas erosa* Ehr.

There are probably several species of this genus, but few are reported probably because they are easily overlooked among dense mixtures of algae where they mostly occur. The cells are relatively larger than *Chroomonas* (Fig. 254) and have a gullet at the anterior end which can be seen as the cells rotate on their axis.

360a (358) Cells with a long anterior horn and 2 or 3 posterior horns. Fig. 256 . . . . ***CERATIUM***

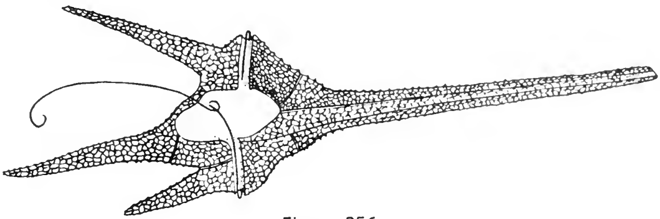

Figure 256

Fig. 256. *Ceratium hirundinella* (O. F. M.) Duj.

This distinctive organism is unmistakably identified. It occurs either intermingled with other algae or in the open water of lakes where, under favorable conditions, it may produce a veritable bloom and may cause the water to be a gray-brown or coffee color. When recently collected, favorable optical conditions will show the trailing flagellum and the one that encircles the cell in the transverse groove. Most species of this genus occur in the sea.

360b Cells without prominent horns as above **361**

361a Cells without a true wall; membrane delicate, not showing a pattern of plates; with a transverse groove which completely encircles the cell. Fig. 257 . . . . ***GYMNODINIUM***

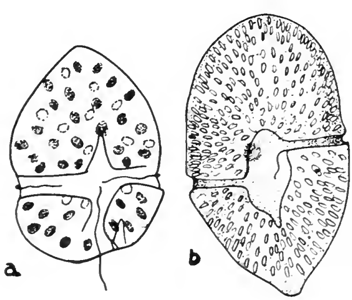

Figure 257

Fig. 257. a, *Gymnodinium palustre* Schilling; b, *G. fuscum* (Ehr.) Stein.

Species of this genus are of wide occurrence but seldom occur in large numbers. They are intermingled among other algae and are usually found very actively swimming in microscope mounts. The thin cell membrane (without a cell wall) that characterizes most fresh-water species helps in identification. The transverse furrow extends around the cell in a downward spiral fashion.

361b Cells with a definite wall; a pattern of definitely arranged plates usually evident; a transverse groove encircling the cell, completely or incompletely **362**

362a Wall thick; plates easily seen, with a suture between the plates usually evident; transverse furrow completely encircling the cell. **363**

362b Wall thin; plates seen with difficulty (especially in filled and living cells); transverse furrow completely encircling the cell or not. **364**

363a Wall with 2 antapical plates (plates at the posterior pole, to be seen in end view of the cell); cell slightly flattened dorsiventrally in most species. Fig. 258.........................***PERIDINIUM***

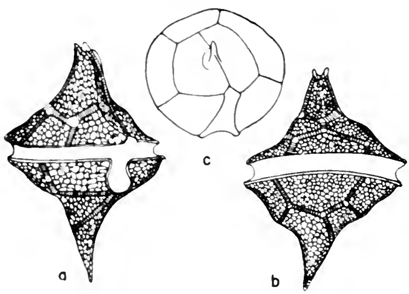

Figure 258

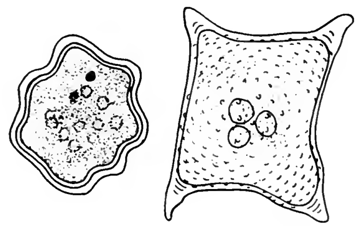

Figure 258 ½

Fig. 258. *Peridinium wisconsinense* Eddy. a, ventral view showing longitudinal sulcus; b, dorsal view; c, posterior polar view showing 2 antapical plates.

Fig. 258½. Encysted Dinoflagellates.

This genus is represented by more species in fresh water than any of the other dinoflagellates. They are differentiated by shape, size and details of plate number and arrangement. The 2 posterior or antapical plates can be determined by patiently rolling the cell so that it can be seen from the bottom. Although very common, these species do not form blooms nor pure growths as does *Ceratium* (Fig. 256).

363b Wall with 1 antapical plate; cell not flattened dorsiventrally (round in cross section). Fig. 259.........................***GONYAULAX***

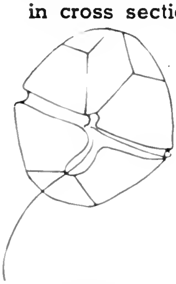

Figure 259

Fig. 259. *Gonyaulax palustre* Lemm.

These almost spherical cells are differentiated from *Peridinium* (Fig. 258) by the presence of but a single antapical plate and the slightly spiralled transverse furrow. Some authorities regard this particular species of the genus as belonging to *Peridinium*.

364a (362) Cells strongly flattened dorsiventrally; plates not evident; transverse furrow not completely encircling the cell. Fig. 260.... .... *HEMIDINIUM*

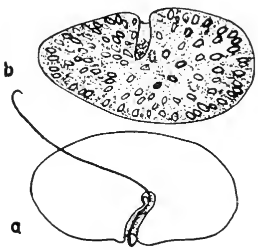

Figure 260

Fig. 260. *Hemidinium nasutum* Stein. a, ventral view; b, dorsal view.

There are several species of this genus reported from the United States. They are differentiated by shape and size of cell and by the pattern of the plates which are usually very delicate and difficult of determination. The cells are very much flattened when seen from the side.

364b Cells not at all or but very little flattened dorsiventrally (nearly round in cross section); plates evident (especially in empty cells); transverse furrow completely encircling the cell. Fig. 261........ .... *GLENODINIUM*

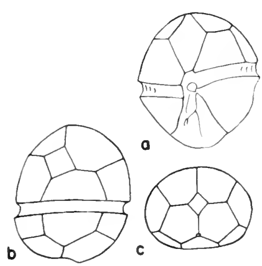

Figure 261

Fig. 261. *Glenodinium Kulczynski* (Wolos.) Schiller. a, ventral view showing longitudinal furrow; b, dorsal view; c, apical view.

The several species of this genus reported from the United States are differentiated by cell size and shape. The plate pattern is much more easily discerned than in *Hemidinium* (Fig. 260) but patience is required in rotating the cell in order to determine this pattern. As in other genera, especially *Peridinium* (Fig. 258) it is desirable to examine empty cells in order to see the wall characters plainly. Most species are globular or if flattened, not so much as in *Hemidinium.*

365a (346) Colony motile by flagella............................366

365b Colony non-motile, or if moving, by rhizopodial processes (pseudopodia) 370

366a Colony globose or subglobose (oval); cells ovoid or pear-shaped, compactly arranged or forming a hollow sphere..............367

366b Colony not globular; cells shaped otherwise..................369

367a Cells bearing 2 long, rigid, rod-like processes at the anterior end. Fig. 262 .... *CHRYSOSPHAERELLA*

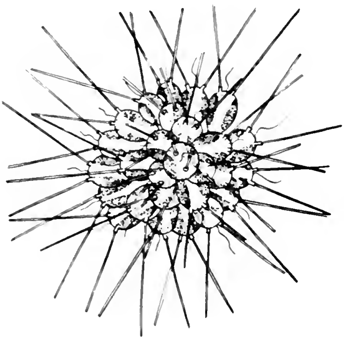

Figure 262

Fig. 262. *Chrysosphaerella longispina* Lauterb.

This distinctive organism is easily identified by the curious long rods, borne in pairs on each cell. The chromatophores are brownish-yellow. Although widely distributed the species (only 1 reported) seems to be rather rare in occurrence.

367b Cells without such rods.. 368

368a Cells elongate-ellipsoid or elongate pear-shaped, rather compactly arranged in the colony; cell wall with minute silicious scales in the anterior end; flagella 2, of equal length. Fig. 263.... *SYNURA*

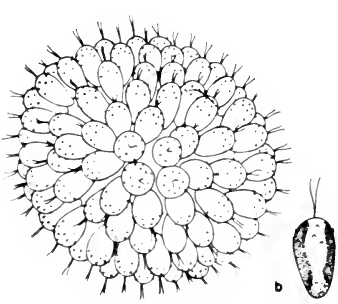

Figure 263

Fig. 263. *Synura uvella* Ehr. a, colony; b, single cell showing silicious spicules in membrane.

This species is very common in hard water lakes and may be so abundant as to produce disagreeable odors and tastes in water supply reservoirs. The chromatophores are golden brown and mask the small spicules in the walls at the anterior end of the cell. These can be determined by proper focusing on colonies that are quiescent. There is another species with longer and narrower cells, *S. Adamsii* G. M. Smith, that is of more rare occurrence.

368b Cells ovoid or pear-shaped, separated and evenly spaced within the colonial envelope; without scales in the wall; flagella 2, of unequal length. Fig. 264 .... *UROGLENOPSIS*

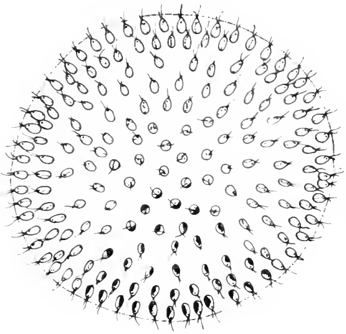

Figure 264

Fig. 264. *Uroglenopsis americana* (Calkins) Lemm.

This species frequents bodies of water that are contaminated with sewage and organic wastes. The colonies are large and contain several hundreds of cells, are sometimes mistaken for *Volvox* (Fig. 15) but is quickly differentiated by the yellow-brown color of the plate-like (not cup-shaped) chromatophores.

369a (366) Cells elongate-ovoid or pear-shaped, compactly arranged side by side in radiate fashion in 1 plane to form a plate with a small opening in the center of the colony; motile by 2 flagella. Fig. 265 .... *CYCLONEXIS*

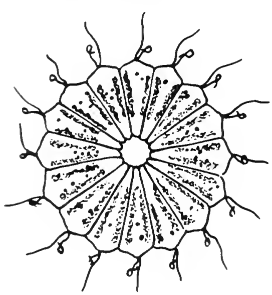

Figure 265

Fig. 265. *Cyclonexis annularis* Stokes. (Redrawn from Stokes).

The flat, disc-like colony of compactly arranged, pear-shaped cells is very distinctive. The flagella are relatively coarse and can be seen easily when the colony is quiescent. There are 2 elongate, lightly pigmented chromatophores.

369b Cells not as above; contained in a vase-shaped envelope, 1 or 2 such envelopes arising from the mouth of the one below to form a branched series. See Fig. 243 .... *DINOBRYON*

370a (365) Individuals furnished with pseudopodia (colony sometimes loosely formed and only temporary) 371

370b Individuals not furnished with organs of locomotion; colonies non-motile 373

371a Cells joined together by long, narrow protoplasmic extensions, arranged in a linear series. Fig. 266........***CHRYSIDIASTRUM***

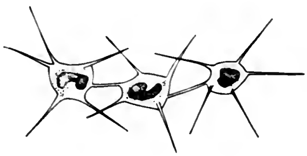

Figure 266

Fig. 266. *Chrysidiastrum catenatum* Lauter. (Redrawn from Smith).

Although this organism may occur singly it is frequently seen adjoined in loose colonies by the interconnecting pseudopodia. There is 1, plate-like or disc-shaped chromatophore.

371b Cells not joined as above..372

372a Pseudopodia numerous, radiating needles; colony formation mostly temporary and incidental. See Fig. 249......***RHIZOCHRYSIS***

372b Pseudopodia short protoplasmic extensions which join individuals to form temporary colonies. See Fig. 250......***CHRYSAMOEBA***

373a (370) Colony consisting of vase-shaped envelopes, 1 or 2 such envelopes arising from the mouth of one below to form forked series (organisms actually motile by flagella, but often appearing quiescent with flagella completely invisible in microscope mounts). See Fig. 243...........................***DINOBRYON***

373b Individuals not cone-shaped; colony formed otherwise........374

374a Thallus a sparsely branched gelatinous cylinder or a mucilaginous network, with cells arranged in 1 to several irregular linear series. Fig. 267....................................***PHAEOSPHAERA***

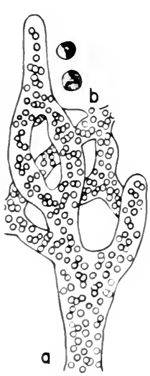

Figure 267

Fig. 267. *Phaeosphaera perforata* Whitford. a, small portion of perforate colony; b, cells showing chromatophores.

The golden brown cells of this species occur in gelatinous masses of irregular shape and of macroscopic size. The thallus may be a stringy mass of mucilage occurring in skeins or meshworks. Unlike *Tetraspora* (Fig. 35) with which it might be mistaken, the cells are not arranged in groups of 4 but occur in irregular series throughout the gelatinous strands.

374b Thallus not a branched gelatinous strand or network........375

375a Cells in clusters of 2-4-8-16 within an irregularly globose colonial investment. Fig. 268 .... ***CHRYSOCAPSA***

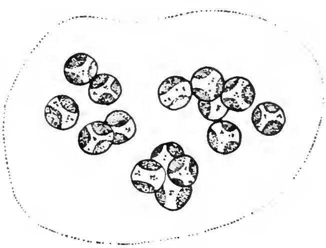

Figure 268

Fig. 268. *Chrysocapsa planctonica* (West & West) Pascher. (Redrawn from Smith).

The colonies of this species are globular, or nearly so, the mucilage clear and transparent, the cells with brownish chromatophores. This is the only species reported which is common, but another one, *C. paludosa* (West & West) Pascher, with oval cells has been recorded.

375b Cells 16-32-64 within a wide, flat colonial mucilage, the cells radially arranged in 1 plane; colonial mucilage impregnated with granular substance. Fig. 269 ...... ***CHRYSOSTEPHANOSPHAERA***

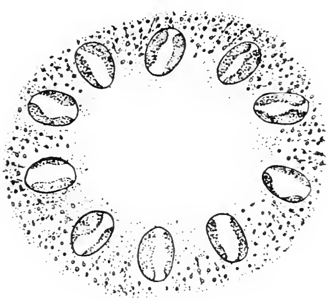

Figure 269

Fig. 269. *Chrysostephanosphaera globulifera* Scherff.

This colony of brown cells is disc-like and is enclosed by a wide gelatinous matrix which invariably contains dark granules of what is regarded as metabolic waste products. Only 1 species is known from this country.

376a (4) Plants filamentous, thread-like (the thread of cells called a *trichome;* trichome and sheath, if present, called a *filament*) ... **377**

376b Plants not definitely filamentous; cells globular, rod-shaped, or angular from mutual compression; solitary, in floating colonies, or forming cushion-like masses in which a suggestion of filamentous arrangement may be apparent **421**

377a Trichome coiled or spiralled in a regular fashion **378**

377b Trichomes otherwise, straight or irregularly twisted (occasionally, however, *Oscillatoria* (Fig. 277) may become twisted about itself to form a regular spiral) **381**

378a Trichome unicellular. Fig. 270 .... ***SPIRULINA***

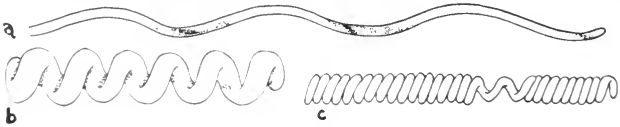

Figure 270

Fig. 270. a, *Spirulina laxissima* G. S. West; b, *S. princeps* (West & West) G. S. West; c, *S. subsalsa* Oersted.

Although essentially unicellular, this genus is thread-like and is included with the Oscillatoriaceae (a filamentous family of the Cyanophyta). Although some species are solitary they are often found in masses either by themselves or intermingled with *Oscillatoria* (Fig. 277). Species are differentiated by size and by type of coiling of the cell. They are usually actively in motion when viewed microscopically. Movement in this and other blue-green genera is accomplished by the extrusion of mucilage.

378b Trichomes multicellular, i.e., with cross walls 379

379a Trichomes composed of bead-like or barrel-shaped cells, with heterocysts present (cells located here and there in the trichome which are larger and sometimes different in shape from the vegetative cells). Fig. 271 .... *ANABAENA*

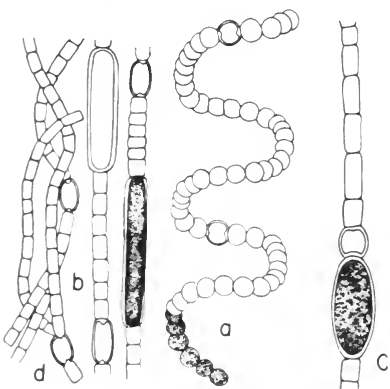

Figure 271

Fig. 271. a, *Anabaena spiroides* var. *crassa* Lemm.; b, *A. subcylindrica* Borge, showing spores; c, *A.* sp., showing oval akinete; d, *A. subcylindrica* Borge, showing heterocysts.

There are many species of this genus, some solitary and some forming colonial masses of indefinite shape. When colonial they are surrounded by a conspicuous mucilage and sometimes are mistaken for *Nostoc* (Fig. 300). The colonial mass is indefinite in shape and the mucilage soft, however. Whereas some forms are truly planktonic species, others occur intermingled with algae in shallow water or on moist soil. The planktonic species may form a bloom in lakes of northern latitudes during summer months, but seldom cause disagreeable conditions in lakes or reservoirs because the plants remain suspended throughout the water and do not form surface scums. *Anabaena* spp. are responsible for the death of cattle and other animals drinking from infested water.

379b Cells not bead-like; heterocysts absent 380

380a Trichomes with a sheath. Fig. 272 ....*LYNGBYA*

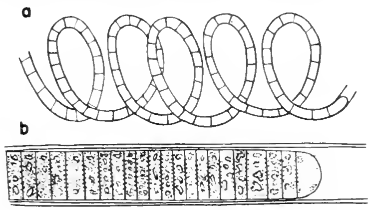

Figure 272

Fig. 272. a, *Lyngbya contorta* Lemm; b, *L. Birgei* G. M. Smith.

Most species are straight and rigid, but a few are coiled; some are planktonic. The definite, rather firm sheath extending beyond the end of the trichome (the row of cells) is characteristic and helps to separate this genus from *Oscillatoria* (Fig. 277). One species, *L. Birgei*, is so characteristically a planktonic species in hard water that it can be used as an index organism.

380b Trichomes without a sheath. Fig. 273 ....*ARTHROSPIRA*

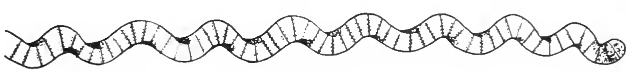

Figure 273

Fig. 273. *Arthrospira Jenneri* (Kuetz.) Stiz.

The plants in this genus are multicellular but at times the cross partitions are difficult to discern and short sections may be mistaken for *Spirulina* (Fig. 270). Species are differentiated mostly by size and form of coiling of the filaments; occur on damp soil of beaches, or in the tychoplankton.

381a (377) Trichomes with cells all alike in shape and size (except trichome) may be tapered, or the apical cell capitate (swollen) .382

381b Trichomes with certain cells enlarged and appearing empty or with homogeneous contents (heterocysts); in some, certain cells become enlarged and develop thick walls, forming spores (akinetes) 397

382a Trichomes tapering from base to apex 383

382b Trichomes not tapering from base to apex, the same diameter throughout, or tapered only in the extreme apical region 385

383a Trichomes aggregated, tapering from a base which is incorporated in a prostrate cushion of cells. Fig. 274............ ***AMPHITHRIX***

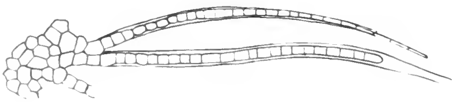

Figure 274

Fig. 274. *Amphithrix janthina* (Mont.) Bor. & Flah. (Redrawn from Bornet & Flahault).

These tapering filaments are arranged in somewhat parallel fashion to form clusters (but without conspicuous mucilage) attached to substrates. There is a weakly developed, prostrate expansion of the thallus from which the filaments arise. The lack of heterocysts (see *Anabaena*, Fig. 271) makes this a somewhat anomalous member of the Rivulariaceae which characteristically has this type of cell at the base of the filament.

383b Without a prostrate cushion of cells at the base of the trichome. **384**

384a Trichomes gregarious, parallel in a colonial mass. See Fig. 274. .... ***AMPHITHRIX***

384b Trichomes solitary or loosely clustered, not parallel. Fig. 275... .... ***CALOTHRIX***

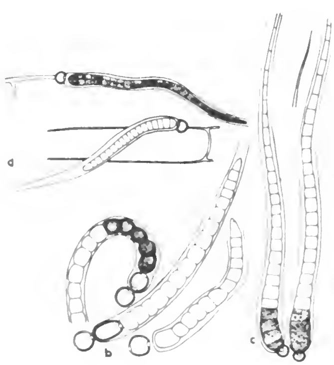

Figure 275

Fig. 275. a, *Calothrix epiphytica* West & West; b, *C. atricha* Fremy; c, *C. Braunii* Bor. & Flah.

These tapering filaments are solitary or loosely clustered, although sometimes gregarious, forming extensive masses. There is a basal heterocyst and in some species, akinetes. Species are differentiated on the basis of size, presence or absence of akinetes, and by the degree of tapering of the trichome, some being very abrupt.

385a (382) **Filaments bearing false branches (a branch formed by proliferation of a broken trichome which pushes off to one side of the main axis; not branching by lateral division of a cell in the main axis); branching often sparse. Fig. 276..........*PLECTONEMA***

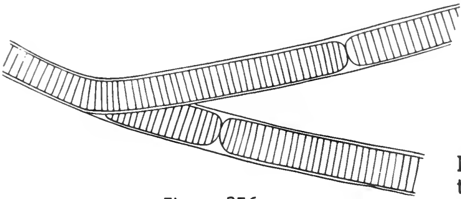

Figure 276

Fig. 276. *Plectonema Wollei* Farlow.

The false habit of branching places this genus in the Scytonemataceae, but unlike other members of the family there are no heterocysts. The species illustrated is a common one, occurring in brownish green or black, cottony masses at or near the surface of the water; is a relatively large species being up to 50 μ in diameter.

385b **Filaments not branched.................................386**

386a **Trichomes without a sheath.............................387**

386b **Trichomes with a sheath................................388**

387a **Trichomes solitary or intermingled, not lying in parallel bundles, sometimes tapered slightly at the anterior end, or with the apical cell swollen (capitate). Fig. 277...............*OSCILLATORIA***

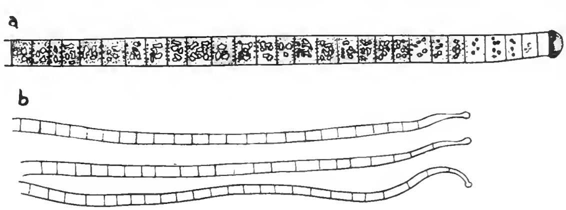

Figure 277

Fig. 277. a, *Oscillatoria rubescens* DeCand.; b, *O. splendida* Grev.

The chief characteristic of species in this genus is their lack of a sheath and another one is their active, oscillating movement. A mass of the plants left in a laboratory dish will creep up the sides of the container. There are numerous species, differentiated on the basis of size and cell proportions and also upon the morphology of the apex of the trichome, sometimes being straight and not tapering, sometimes tapering and possessing a swollen apical cell.

387b Trichomes lying in parallel bundles, not tapered at the anterior end; apical cell never capitate. Fig. 278......*TRICHODESMIUM*

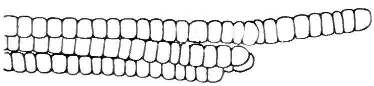

Figure 278

Fig. 278. *Trichodesmium lacustre* Kleb.

This is a species of uncertain position because it has an *Anabaena*-like filament, but without heterocysts. The filaments are arranged in parallel bundles which form free-floating, dark-green flakes. The cells contain numerous pseudovacuoles (gas pockets). *T. erythraceum* Ehr. is a marine species which, because of light refraction from pseudovacuoles, produces a color that gives the Red Sea its name.

388a (386) Sheath containing one trichome......................389

388b Sheath containing more than one trichome.................394

389a Sheath firm and definite, not adhering to sheaths of adjacent filaments 390

389b Sheath soft and sticky, often adhering to sheaths of adjacent plants and intermingling (confluent) with them.............391

390a Sheaths purple or reddish, conspicuously stratified. Fig. 279.... ....*PORPHYROSIPHON*

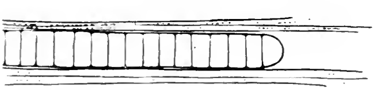

Figure 279

Fig. 279. *Porphyrosiphon Notarisii* (Menegh.) Kuetz.

The purple color of the lamellated sheath of this species accounts for the brightly colored patches on damp soil in subtropical sections of the country. There is but 1 species recorded for the United States.

390b Sheaths colorless or yellowish, not stratified, or indistinctly so. See Fig. 272...*LYNGBYA*

391a (389) Filaments forming an expanded plant mass with or without erect tufts 392

391b Filaments not forming an expanded mass or stratum 393

392a Plant mass having erect tufts. Fig. 280 . . . . *SYMPLOCA*

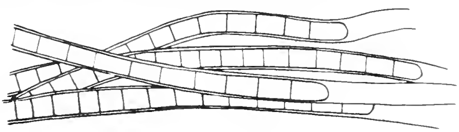

Figure 280

Fig. 280. *Symploca muscorum* (Ag.) Gom.

Filaments of this species occur in erect tufts in moist aerial situations. Species which have thin, sticky sheaths should be compared with *Phormidium* (Fig. 281) with which they may be confused if seen individually and not in colonial mass.

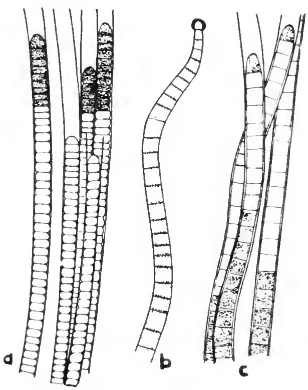

Figure 281

392b Plant mass without erect tufts. Fig. 281 . . . . *PHORMIDIUM*

Fig. 281. a, *Phormidium ambiguum* Gom.; b, *P. favosum* (Bory) Gom.; c, *P. inundatum* Kuetz.

There are numerous species of this genus, differentiated by size and by characteristics of the apical cell of the trichome. The sheaths are thin and sticky, hence the plants form rather closely compacted mats that coat over submerged surfaces. Such a mat when handled does not break apart easily (as somewhat similar-appearing growths of *Oscillatoria*, Fig. 277, might do). The plant masses are blue- or black-green in color and feel slimy or slippery to the touch.

393a (391) Filaments lying parallel in free-floating bundles. See Fig. 278 . . . . *TRICHODESMIUM*

393b Filaments irregularly intermingled, not arranged in free-floating bundles. Fig. 281½..........................*PHORMIDIUM*

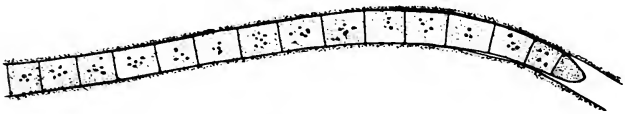

Figure 281½

Fig. 281½. Phormidium sp. Isolated filament.

394a (388) Sheaths soft and sticky, without an even, definite outer boundary 395

394b Sheaths firm and definite, not mucilaginous.................396

395a Sheaths containing 2 or 3 trichomes. Fig. 282...*HYDROCOLEUM*

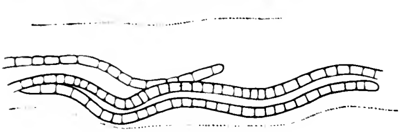

Figure 282

Fig. 282. *Hydrocoleum oligotrichum* A. Braun.

In this genus there are only 3 (sometimes 4) trichomes within a wide, lamellate, gelatinous sheath. The filaments may be solitary or spread in a thin layer on damp soil. *H. oligotrichum* usually is lime-encrusted, whereas *H. homeotrichum* Kuetz. is not.

395b Sheaths containing many trichomes. Fig. 283....*MICROCOLEUS*

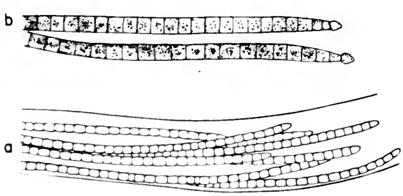

Figure 283

Fig. 283. a, *Microcoleus vaginatus* (Vauch.) Gom.; b, *M. lacustris* (Rab.) Farlow.

There are several species of this genus, differentiated by size and character of the apical cell. Unlike *Hydrocoleum* (Fig. 282) there are many intertwined trichomes in each sheath. Usually the trichomes show an active slithering motion over one another, may emerge from the end of the sheath and then retract. The thallus is often of macroscopic size as it grows on damp soil. Some species are more often found on submerged substrates, however.

396a (394) Sheaths wide, containing 2 or 3 loosely arranged trichomes. Fig. 284....................................*DASYGLOEA*

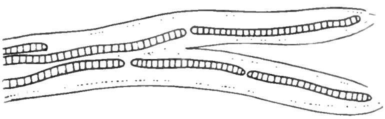

Figure 284

Fig. 284. *Dasygloea* sp.

The sheaths of the plants in this genus are rather firm and definite in outline, contain but 1 to 3 trichomes. See *D. amorpha* Berk. The sheaths are usually forked or branched at the ends (as they are also in *Schizothrix*, Fig. 285, with which it should be compared). Only one species is reported from the United States.

396b Sheaths close, usually containing several crowded trichomes. Fig. 285 ....*SCHIZOTHRIX*

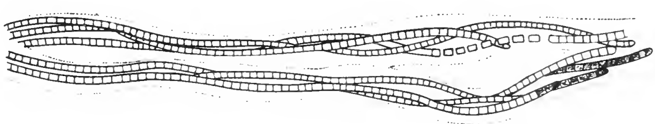

Figure 285

Fig. 285. *Schizothrix tinctoria* Gom.

In this genus there are but few trichomes within a definite and rather firm sheath. The plant masses are of macroscopic size and often form streaming masses, or films and wefts over submerged vegetation. Several of the species quickly disintegrate when stored in a covered container for a short time without preservative and liberate a copious amount of the phycocyanin pigment which is present in blue-green algae. There are at least a dozen species reported from the United States, differentiated by size and cell proportions.

397a (381) Trichomes tapering from base to apex................398

397b Trichomes not tapering from base to apex..................402

398a Filaments inclosed within abundant mucilage, forming a globular or hemispherical body, attached or free-floating..............399

398b Filaments not inclosed by abundant mucilage to form a thallus of definite shape...401

399a Sheath containing 2 or more trichomes. Fig. 286...*SACCONEMA*

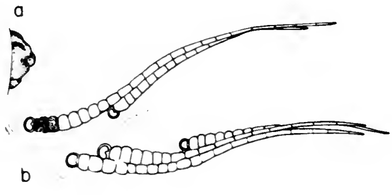

Figure 286

Fig. 286. *Sacconema rupestre* Borzi. a, habit of colony; b, filaments from colony.

Trichomes in this genus are tapering from a basal heterocyst as in *Gloeotrichia* (Fig. 287) but there is more than 1 trichome within a sheath and the gelatinous colony is very irregular in shape as it occurs on stones (sometimes in very deep water). The sheaths are wide, lamellate and are flaring at the outer end.

399b Sheath containing 1 trichome..............................400

400a With cylindrical spores adjoining a basal heterocyst; colonial mucilage soft in floating species, firm when attached to substrates and then forming hemispherical growth 1-3 mm. in diameter. Fig. 287..................................*GLOEOTRICHIA*

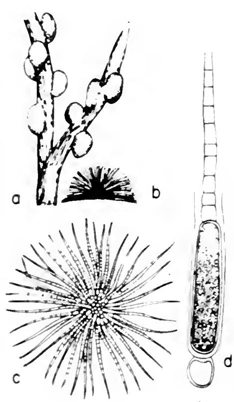

Figure 287

Fig. 287. a, *Gloeothrichia Pisum* (Ag.) Thur., habit on *Ceratophyllum*; b, diagram of filament arrangement; c, *G. echinulata* (J. E. Smith) P. Richter, diagram of filaments in colony; d, diagram of base of single filament showing heterocyst and spore.

In this genus the tapering trichomes are encased in mucilage which is usually soft (although firm in 1 species) and they are not so closely compacted as in *Rivularia* (Fig. 288), a genus which is very similar. *Gloeotrichia* produces filaments with large akinetes (spores) adjoining the basal heterocyst when mature. One of the most common species is the free-floating *G. echinulata* which occurs in abundance in some lakes and gives the appearance of the water being filled with tiny tapioca-like grains, buff-colored. *G. natans* (Hedw.) Rab. is also fairly common. It begins as an attached plant but late in the growing season it appears at the surface in brown gelatinous masses, either expanded and flat or irregularly globular. *G. Pisum* forms hard, green or black balls, 1 or 2 mm. in diameter on submerged vegetation, sometimes completely covering the host plant. When plants in this genus are young the spores will not be present, in which case they may be confused with *Rivularia* (Fig. 288) which never produces spores, has a much harder colonial mucilage and has trichomes more densely packed, often parallel in arrangement.

400b Spores absent; trichomes embedded in hard mucilage to form globular thalli which may coalesce, thus producing a continuous stratum; trichomes parallel and densely compacted or radiate. Fig. 288 .... *RIVULARIA*

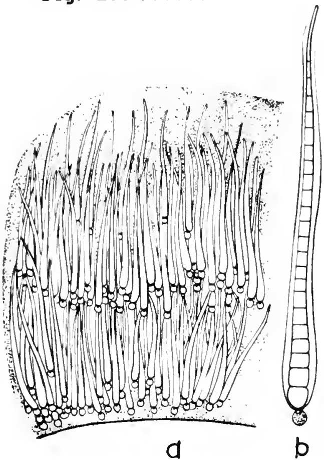

Figure 288

Fig. 288. *Rivularia* sp. a, diagram of portion of attached colony to show arrangement of filaments; b, one filament showing basal heterocyst.

There are several species of this genus reported from the United States. They may be differentiated from *Gloeotrichia* by the hardness of the mucilage, the compactness of arrangement of the trichomes, and the absence of akinetes. Small globular balls or expanded masses of dark green mucilage occur on rocks or submerged logs, etc. Some species grow in moist aerial surfaces, especially marine forms. *Rivularia* is not found free-floating, whereas *Gloeotrichia* (Fig. 287) usually is. See notes under the latter genus.

401a (398) Filaments branching freely; the basal portion of the branches lying within the sheath of the main filament for some distance, then diverging. Fig. 289 .... *DICHOTHRIX*

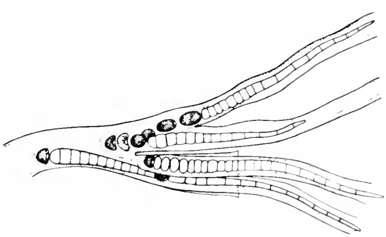

Figure 289

Fig. 289. *Dichothrix gypsophila* (Kuetz.) Bor. & Flah.

In this genus the tapering trichomes are enclosed 2 or 3 together within branching sheaths. Brush-like tufts are produced by their habit of growth and these sometimes attain macroscopic proportions. The species are differentiated by size and sheath characters. They are customarily found intermingled with miscellaneous algae; are sometimes attached or at least adherent to aquatic plants.

401b Filaments not branched (or seldom so); if branched, the branches not inclosed in the sheath of the main filament. See Fig. 275. .... *CALOTHRIX*

402a (397) Trichomes branching by lateral division of cells of the main axis (true branching) 403

402b Tichomes unbranched, or with false branches (sections of trichome developing a series of cells to one side of a break in the main axis) 406

403a Individual trichome sheath not apparent; colony of trichomes invested by a mucilage; heterocysts usually on the ends of short branches. Fig. 290 .... *NOSTOCHOPSIS*

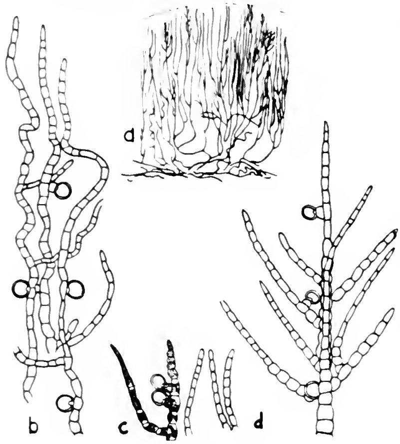

Figure 290

Fig. 290. *Nostochopsis lobatus* Wood. a, diagram of filament arrangement in colony; b-d, filaments and lateral heterocysts.

This is the only species reported from the United States. The filaments are composed of *Anabaena*-like cells and bear true branches. The heterocysts are borne laterally along the filaments or on the ends of short branches (rarely intercalary also). The filaments are colonial and are inclosed in a firm mucilage in the form of cylinders or hollow tubes which extend vertically from the bottom in quiet water, or lie horizontally in currents. In shallow water the gelatinous tubes may reach the surface and then broaden and flatten horizontally.

403b Individual trichome sheaths evident; heterocysts in the same series with the main axis, or cut off laterally from them but not on the ends of branches 404

404a Filaments closely aggregated, forming an attached, gelatinous thallus 1-2 mm. in diameter. Fig. 291 .... *CAPSOSIRA*

Fig. 291. *Capsosira Brebissonii* Kuetz. a, habit of attached colony; b, portion of filament showing lateral heterocysts. The sheath is thin and soft without a definite limiting membrane.

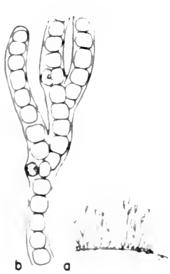

Figure 291

This species builds small bulbous mucilaginous colonies attached to the substrate. The individual trichomes which bear true branches are surrounded by a definite sheath which is yellowish. Heterocysts are usually lateral, but may be intercalary in the trichomes which do not taper toward the apices. There is but 1 species reported from widely separated stations in the United States.

404b Filaments not forming a definitely shaped gelatinous thallus, but spreading irregularly....................................405

405a Filaments with more than 1 series of cells within a wide gelatinous sheath; heterocysts small, cut off laterally from the vegetative cells. Fig. 292.................................*STIGONEMA*

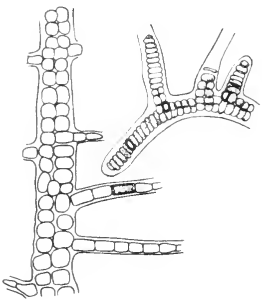

Figure 292

Fig. 292. a. *Stigonema muscicola* Borzi (Fischerella muscicola (Thur.) Gom.); b, S. *turfaceum* (Berk.) Cook.

Although there are several species reported from the United States, S. *turfaceum*, and S. *ocellatum* (Dillw.) Thur. are by far the most common. The latter is one which frequently does not show the multiseriate arrangement of cells. The sheath is wide and mucilaginous and in some species is distinctly lamellate. The heterocyst typically is cut off laterally from a vegetative cell. S. *ocellatum* shows intercellular connections. These species form brownish or blue-green growths on submerged reed stems, on exposed roots, and on other aquatic vegetation, or they may occur as velvety growths on moist soil, rocks, or concrete. *Stigonema ocellatum* invariably is found in acid water (desmid) habitats.

405b Filaments with cells in 1 series within a narrow sheath; heterocysts within the series of vegetative cells (intercalary). Fig. 293. ....*HAPALOSIPHON*

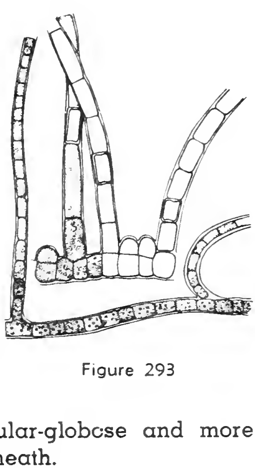

Figure 293

Fig. 293. *Hapalosiphon hibernicus* West & West.

This genus is differentiated from *Stigonema* (Fig. 292) principally by the fact that the cells are always arranged in a single series with the heterocyst (usually somewhat rectangular) intercalary rather than lateral. Species are differentiated mostly by size and by habit of growth, some sprawling irregularly over a substrate, others branching more regularly and erect. Whereas *Stigonema* cells are usually rounded or oval and sometimes show intercellular connections, those of *Hapalosiphon* are ordinarily quadrate or quadrangular-globose and more compactly arranged within a close, thinner sheath.

406a (402) Trichomes unbranched 407

406b Trichomes with false branches 417

407a Individual trichome sheath firm and definite; heterocyst basal (rarely intercalary heterocysts also). Fig. 294.... *MICROCHAETE*

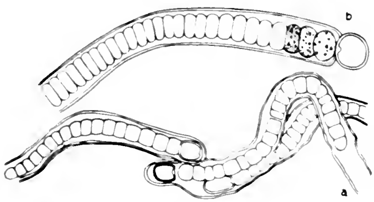

Figure 294

Fig. 294. a, *Microchaete diplosiphon* Gom.; b, *M. robusta* Setch. & Gard.

Plants of this genus are mostly epiphytic, with part of the filament lying parallel with the substrate and then curving away. The filaments do not taper (or scarcely so) and although there may be intercalary heterocysts they usually are basal. There are 4 species described from the United States.

407b Individual sheath soft, often indistinct and intermingled with colonial mucilage; heterocysts either all terminal or all intercalary 408

408a Heterocysts terminal 409

408b Heterocysts intercalary 410

409a Spores adjacent to the heterocysts which usually are at one end of the trichome. Fig. 295 .... *CYLINDROSPERMUM*

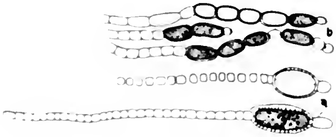

Figure 295

Fig. 295. a, *Cylindrospermum majus* Kuetz.; b, *C. marchicum* Lemm.

The chief characteristic of this genus is the location of the heterocysts and spores, always terminal and usually only at one end of the trichome which does not taper at the extremeties. The plants form gregarious patches or films over submerged vegetation. The spores are formed singly or in series just back of the heterocyst. Frequently a dense 'nest' of spores will be found left where there has been a colony of filaments. Some species are terrestrial.

409b Spores not adjacent to the heterocysts; heterocysts at both ends of the trichome. Fig. 296 .... *ANABAENOPSIS*

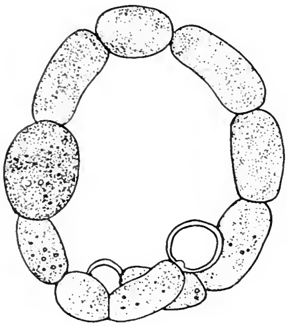

Figure 296

Fig. 296. *Anabaenopsis Elenkinii* Miller. (Redrawn from Smith).

There are 3 species of this genus reported from the plankton in the United States. The trichomes are usually relatively short and are coiled.

410a (408) Thallus composed of many trichomes; usually parallel within colonial mucilage 411

410b Plant a solitary trichome, or if aggregated, not parallel, but entangled within colonial mucilage 413

411a Trichomes inclosed in abundant mucilage; arranged to form a hollow, attached tubular thallus. Fig. 297 .... *WOLLEA*

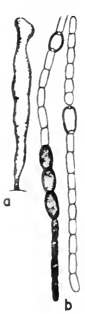

Figure 297

Fig. 297. *Wollea saccata* (Wolle) Born. & Flah. a, habit of colony; b, trichomes in detail showing heterocysts, and akinetes in a series.

The filaments of this species lie more or less parallel in long, gelatinous, tube-like or sac-like thalli which grow vertically from the bottom in standing water. The cells are barrel-shaped or *Anabaena*-like, and the intercalary heterocysts are cylindrical or nearly so.

411b Thallus not a gelatinous tube 412

412a Trichomes parallel, forming a free-floating flake or bundle, containing a single heterocyst and a spore near the middle of each trichome. Fig. 298 . . . . *APHANIZOMENON*

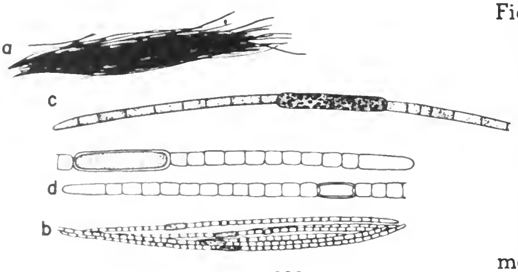

Figure 298

Fig. 298. *Aphanizomenon flos-aquae* (L.) Ralfs. a, diagram of colony; b, a few trichomes from the colony; c-d, trichomes in detail showing medially located cylindrical akinete.

This is the only common species reported from this country and is very widely distributed in lakes which are rich in nitrogen and phosphorus. The trichomes lie in parallel bundles and form flakes of macroscopic size. Because of the gas vacuoles (pseudovacuoles) the plants float high in the water and form surface scums and mats. Hence they are able to cause serious trouble in lakes and reservoirs used for water supplies and pleasure resorts. During summer months the species may develop a "bloom" condition and be so abundant as to give the water the appearance of "pea soup." Considerable economic loss is suffered as a result of the disturbance caused by *Aphanizomenon* when it leads to the death of fish. It is a plant that usually accompanies human settlement about lakes and rarely is the plant found in abundance in lakes remote from habitation.

412b Trichomes not parallel, or if so, forming indefinitely shaped flakes. See Fig. 271 (in part) . . . . *ANABAENA*

413a (410) Trichomes planktonic, solitary 414

413b Trichomes colonial, in a gelatinous mass 415

414a Vegetative cells and heterocysts disc-shaped, wider than long. Fig. 299 . . . . *NODULARIA*

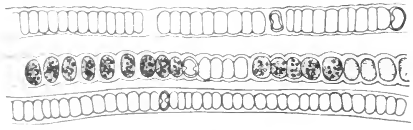

Figure 299

Fig. 299. *Nodularia spumigena* Mert.

Filaments of this species are at once distinguishable by the very short, compressed vegetative cells and heterocysts. The sheath is rather thin and mucilaginous and sometimes is not immediately apparent. The species illustrated is the most common of the 4 that are reported from the United States. Plants of this genus are usually found intermingled with miscellaneous algae from the tychoplankton.

414b Cells globose to cylindric, or barrel-shaped, not compressed as above. See Fig. 271 .... *ANABAENA*

415a (413) Plant mass definite in shape, usually globular, bound by a firm, gelatinous tegument; colonies microscopic or macroscopic. Fig. 300 .... *NOSTOC*

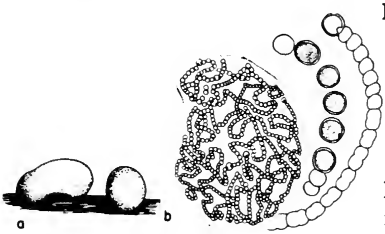

Figure 300

Fig. 300. a, *Nostoc pruniforme* Ag., showing habit of colonies; b, *N. linckia* (Roth) Bor. & Flah., with two trichomes in detail showing heterocyst and akinetes.

This genus is characterized chiefly by the firm outer tegument of the mucilaginous material in which numerous bead-like filaments are inclosed, thus giving the thallus a definite form. One species forms colonies as large as a goose egg, whereas another, *N. commune* Vauch., builds tough, membranous green or brown layers on the bottoms of pools or in swampy places, sometimes in wet alpine meadows. *N. pruniforme* is a very common species which forms marble- or acorn-sized colonies on damp soil, often among grasses in marshy meadows. The globular or oval thalli are frequently mistaken for turtle or some other type of reptilian egg. *N. amplissimum* Gard. is known as Mare's Eggs in the far West where it produces colonies 10 cm. in diameter.

415b Plant mass not definite in shape; mucilage soft, not bounded by a firm tegument 416

416a Trichomes forming small bundles within a gelatinous sheath, either entangled or parallel. Fig. 301 .... *AULOSIRA*

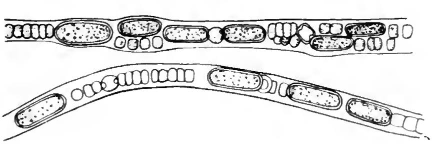

Figure 301

Fig. 301. *Aulosira laxa* Kirch.

This species (the only one of the genus found in the United States) is much like *Microchaete* (Fig. 294) and the genus is sometimes classified with it. Some authorities differentiate it on the basis of the soft sheath, the intercalary heterocysts, and the akinetes which occur intercalary and of the same size and proportions as the heterocysts.

416b Trichomes not forming bundles. See Fig. 271 .... *ANABAENA*

417a (406) Branches arising in pairs about midway between 2 heterocysts (branching rarely solitary). Fig. 302.........**SCYTONEMA**

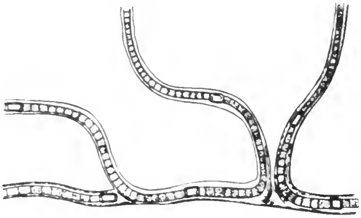

Figure 302

Fig. 302. *Scytonema Archangelii* Born. & Flah.

There are several species of this genus which are very common. Although some branch rather seldom, most of them show numerous false branches which arise singly or in pairs between the heterocysts. They are plants of both aquatic and subaerial habitats. Species are differentiated by size, shape of cell, and sheath characters.

417b Branches arising singly just below a heterocyst or a series of them; (branching sometimes rare and not definite, requiring a search through a number of plants to determine this character). 418

418a Sheath close and firm, 1 trichome in a sheath..............419

418b Sheath usually wide and soft; at least more than 1 trichome within a sheath...420

419a Branches frequent, arising just below the heterocysts which are always intercalary. Fig. 303.....................**TOLYPOTHRIX**

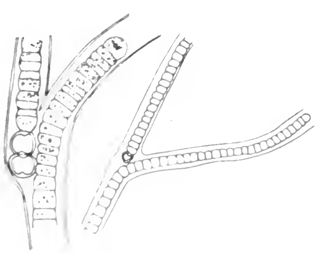

Figure 303

Fig. 303. *Tolypothrix distorta* Kuetz.

This genus is differentiated from *Scytonema* (Fig. 302) principally by the fact that the false branch always arises below a heterocyst or sometimes below a series of them. There are several species that are common, differentiated by size and by sheath characters, some of which are thick and lamellate, others thin and soft.

419b Branches rare; heterocysts terminal (rarely intercalary also). See Fig. 294 ....**MICROCHAETE**

420a (418) Trichomes parallel within a fairly wide sheath; plant mass developing bushy tufts; heterocysts basal in the trichome. Fig. 304 .... *DESMONEMA*

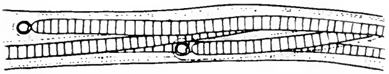

Figure 304

Fig. 304. *Desmonema Wrangelii* (Ag.) Born. & Flah.

The falsely branched filaments of this species differ from others in the Scytonemataceae by having several trichomes within 1 sheath. The filaments are gregarious and form plant masses of macroscopic size on moist aerial substrates, and usually show erect tufts. This is the only species reported from the United States.

420b Trichomes twisted and entangled in a wide sheath; heterocysts intercalary. Fig. 305............................ *DIPLOCOLON*

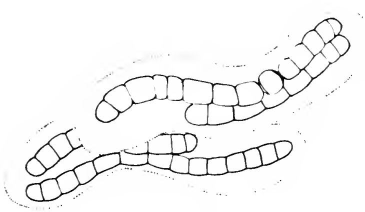

Figure 305

Fig. 305. *Diplocolon Heppii* Naeg. (Redrawn from Smith).

This plant forms an expanse on moist aerial substrates such as dripping rocky cliffs. The trichomes are falsely branched, have intercalary heterocysts and are inclosed several together in a wide gelatinous sheath.

421a (376) Plants attached; cells club-shaped or with other shapes, gregarious, forming cushion-like masses or horizontal expanses, or solitary; epiphytic or growing on shells; cells usually showing endospores (segments of the protoplast rounded up and forming reproductive bodies which are spore-like).................. 422

421b Plants not attached; cells mostly spherical, hemispherical, or rod-shaped, not forming cushion-like masses nor horizontal expanses; endospores lacking 427

422a Cells erect, subcylindrical clubs, straight or curved; epiphytic; endospores cut off successively at the tips of cylindrical protoplasts. Fig. 306 .... *CHAMAESIPHON*

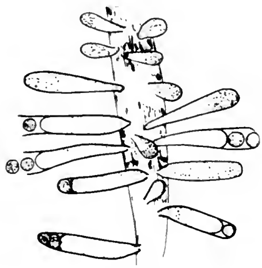

Figure 306

Fig. 306. *Chamaesiphon incrustans* Grunow.

These club-shaped or cylindrical plants grow as epiphytes on filamentous algae and whereas they may be solitary they usually occur in gregarious patches. When mature the end of the protoplast cuts off rounded-up spores, "endospores" which float away as regenerative elements.

422b Cells some other shape; gregarious, forming horizontal expanses or cushions 423

423a Perforating shells, forming short irregular, spreading filaments (filamentous character not clearly evident). Fig. 307 ..... *HYELLA*

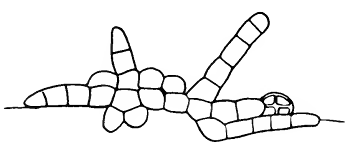

Figure 307

Fig. 307. *Hyella fontana* Huber & Jadin.

Most species of this genus are marine but some occur in fresh water, boring into shells of molluscs. The plant is a short, irregularly branched filament, sometimes forming a cushion-like mass. The substrate must be treated with dilute acetic acid to dissolve away the lime before the plants can be studied satisfactorily.

423b Not perforating shells; plant mass expanded or cushion-like . . 424

424a Plant mass composed of cells arranged in 1 layer. Fig. 308 ....
.... *XENOCOCCUS*

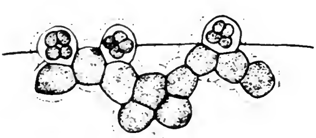

Figure 308

Fig. 308. *Xenococcus Schousbei* Thur.

There are at least 2 species of this genus found in the fresh waters within the United States, most forms being marine. They occur as patches of blue-green cells, compactly arranged as epiphytes on filamentous algae. Cells form endospores although they may reproduce actively by fission.

424b Plant mass in the form of a cushion with cells arranged in vertical rows 425

425a Cells surrounded by a sheath; plant mass thick, cartilaginous, usually macroscopic. Fig. 309 .... *CHONDROCYSTIS*

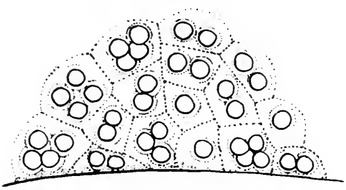

Figure 309

Fig. 309. *Chondrocystis Schauinslandii* Lemm.

This species forms extensive, cushion-like masses on exposed surfaces and are heavily encrusted with lime. The colonial mass is inclosed by a tough mucilage in which 'families' of cells are surrounded by individual sheaths. This is the only species in the genus and seems to have been reported but a few times from the United States.

425b Cells not inclosed by a thick sheath; plant mass macroscopic. . 426

426a Plant mass forming a flat, encrusting layer; cells forming short, erect unbranched filaments. Fig. 310 .... *PLEUROCAPSA*

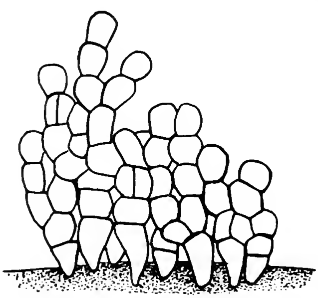

Figure 310

Fig. 310. *Pleurocapsa minor* Hansg.

In this genus the plant mass is essentially filamentous but the cells are so closely appressed that the branching habit cannot be determined easily without dissecting. Encrusting thralli are produced with some differentiation between the lower or inner cells and those near the surface which produce the endospores.

426b Plant mass cushion-like; cells forming erect branched filaments. Fig. 311 .... *ONCOBYRSA*

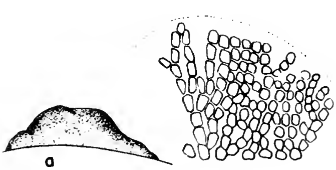

Figure 311

Fig. 311. *Oncobyrsa* sp. a, habit of colony; b, diagram of cell arrangement.

Oncobyrsa rivularis is the most common species of this genus. It has compactly arranged series of cells in which the filamentous plan can be more easily determined than in *Pleurocapsa* (Fig. 310). The thallus is a mound of cells, encased in a tough mucilage on filamentous algae. Although the general habit is that of members of Chamaesiphonaceae, there have been no endospores observed.

427a (421) Cells globose, or hemispherical because of recent cell division 428

427b Cells some other shape....................441

428a Cells inclosed in mucilage and bearing a long gelatinous hair. See Fig. 206....................*GLOEOCHAETE*

428b Cells not in a sheath which bears a hair....................429

429a Protoplasts occurring as bright blue-green, vermiform bodies, radiately arranged or scattered within *Oocystis*-like cells (see *Oocystis*, Fig. 85), inclosed by mother-cell wall. See Fig. 208.................... *GLAUCOCYSTIS*

429b Cells not as above....................430

430a Cells solitary or grouped in small families of 2-4-8 (rarely as many as 16) individuals, if more than 16, then in a flat plate........431

430b Cells aggregate in larger numbers, inclosed by a mucilaginous sheath 435

431a Cells solitary or in pairs, without a gelatinous sheath. Fig. 312. ....*SYNECHOCYSTIS*

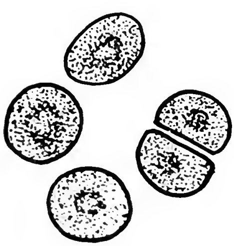

Figure 312

Fig. 312. *Synechocystis aquatilis* Sauv.

This is a rather rare species which is probably of more common occurrence than is evidenced by the records of it from this country. There are globular cells, solitary or in pairs, without a mucilaginous sheath being apparent. The densely granular 'central' body of the cells is more complex than for other genera in the Chroococcaceae.

431b Cells inclosed by a mucilaginous sheath (sometimes indistinct). 432

432a Cells arranged in rectilinear series to form a flat plate. Fig. 313. .... *MERISMOPEDIA*

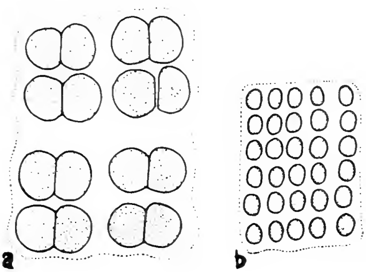

Figure 313

Fig. 313. a, *Merismopedia elegans* var. *major* G. M. Smith; b, *M. glauca* (Ehr.) Naeg.

There are several species on record from the United States, differentiated by cell shape, color, and presence of vacuoles. The genus is easily distinguishable by the definite arrangement of the cells in rectilinear series. *M. convoluta* Breb. is an uncommon species which has relatively large plates that are enrolled at the margin.

432b Cells not arranged in rectilinear series.................... 433

433a Cells heart-shaped or round, occurring at the ends of radiating strands of mucilage (focus down into the colony and cut down illumination to detect presence of radiating strands). Fig. 314. .... *GOMPHOSPHAERIA*

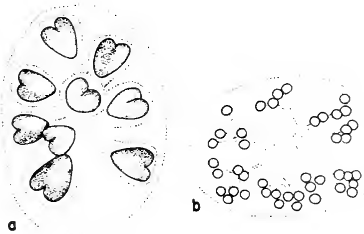

Figure 314

Fig. 314. a, *Gomphosphaeria aponina* Kuetz.; b, *G. lacustris* Chod.

These plants are characterized by having cells in globular colonies, closely or distantly arranged at the ends of mucilaginous strands that radiate from the center of the thallus. *G. lacustris* is frequently found in the euplankton, whereas *G. aponina* occurs mostly in the tychoplankton.

433b Cells not at the ends of radiating strands.................. 434

434a Groups of cells inclosed in concentric layers of mucilage; colonial investment intermingling (confluent) with sheaths of other groups and so forming gelatinous masses, mostly on moist substrates; sheaths showing definite concentric rings. Fig. 315............ ....*GLOEOCAPSA*

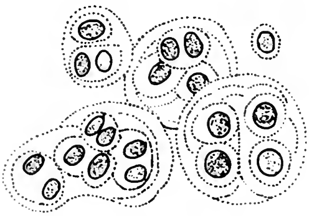

Figure 315

Fig. 315. *Gloeocapsa punctata* Naeg.

This is a genus in which globular cells are inclosed, many 'families' together within gelatinous masses of considerable size. A common habitat is the surface of moist rocks and cliffs, soil in greenhouses, moist cement work, etc. Cells, pairs of cells, or clusters of cells are inclosed in concentric layers of mucilage. Many species, especially when few cells are involved, can scarcely be differentiated from *Chroococcus* (Fig. 316) and there is a disposition among some specialists to place the two genera together.

434b Colonial mucilage not intermingling with that of other colonies; families of cells separated from one another, usually free-floating but commonly inhabiting soil and moist substrates in aerial situations; colonial sheath usually without conspicuous concentric rings. Fig. 316..............................*CHROOCOCCUS*

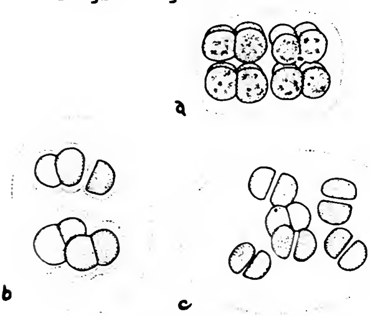

Figure 316

Fig. 316. a, *Chroococcus Prescottii* Drouet & Daily; b, *C. limneticus* var. *distans* G. M. Smith; c, *C. limneticus* Lemm.

There are numerous species in this genus, many of them inadequately described and differentiated. The genus is separated from *Gloeocapsa* (Fig. 315) mostly on the basis of the fewness of cells involved in a colony and by the fact that 'families' of cells are not all inclosed in a common lamellated mucilaginous matrix. The colonies are usually composed of no more than 16 cells and more commonly of but 4, 8 or 12 cells. A few species are definitely planktonic but others occur attached to aquatic substrates or form films on aerial surfaces. *C. turgidus* (Kuetz.) Naeg. is a large species in which cells occur in 2's and 4's within a stratified envelope and is one that is invariably found in desmid habitats where the water is acid.

435a (430) Cells arranged to form a flat plate....................436

435b Cells forming irregularly globular or oval colonies.........437

436a. Cells arranged in rectilinear series. See Fig. 313 .... *MERISMOPEDIA*

436b Cells irregularly arranged. Fig. 317 .... *HOLOPEDIUM*

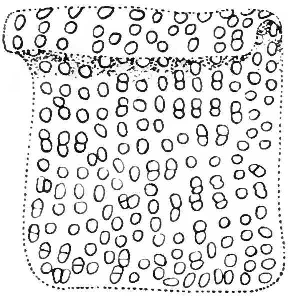

Figure 317

Fig. 317. *Holopedium irregulare* Lag.

This genus differs from *Merismopedia* by having the cells irregularly arranged within a gelatinous plate. Only this species has been reported for the genus from the United States.

437a (435) Colony globular, rather definite in shape 438

437b Colony irregular in outline 440

438a Cells very numerous and crowded within the colonial mucilage (usually showing false vacuoles which refract the light so that the cells appear brownish, black or purplish). Fig. 318 .... *MICROCYSTIS*

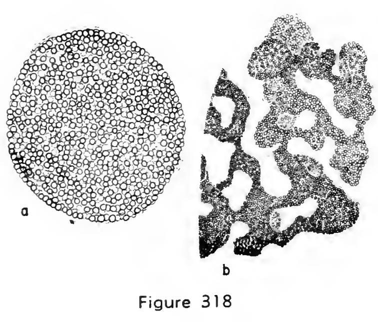

Figure 318

Fig. 318. a, *Microcystis flos-aquae* (Wittr.) Kirch.; b, *M. aeruginosa* Kuetz. emend Elenkin.

The marble-like cells of this genus are closely compacted and irregularly arranged in definitely shaped but irregular colonies inclosed in mucilage. *M. flos-aquae* has more nearly globular and symmetrically shaped colonies than *M. aeruginosa*. The cells often contain pseudovacuoles (gas pockets) and float high in the water. Hence they produce surface scums and like *Aphanizomenon* (Fig. 298) cause a great deal of disturbance in lakes and reservoirs. Dense growths may lead indirectly to the death of fish through suffocation. It is rather curious that where these species occur (especially *M. aeruginosa*) the water is completely dominated by the plant to the exclusion of almost all other forms. It has often been noted that a lake may be densely overgrown with either *Microcystis* or with *Aphanizomenon*, but not the two together. There are several species of the genus differentiated by size and by details of the sheath structure, and by form of colony.

438b Cells not densely crowded but evenly spaced or regularly arranged 439

439a Cells in one layer at the periphery of the mucilage. Fig. 319. ....*COELOSPHAERIUM*

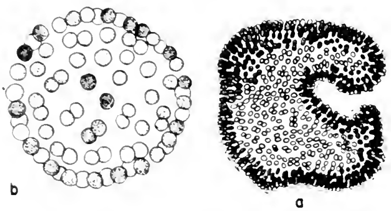

Figure 319

Fig. 319. a, *Coelosphaerium Naegelianum* Unger; b, *C. Kuetzingianum* Naeg.

There are 2 common species of this genus which are members of the open water plankton. As the name suggests, the cells are arranged so as to form a hollow colony. *C. Naegelianum* has cells which contain pseudovacuoles which are light refractive and the colony appears brownish-purple or even black rather than blue-green when seen microscopically.

439b Cells distributed throughout the colonial mucilage. Fig. 320.... ....*APHANOCAPSA*

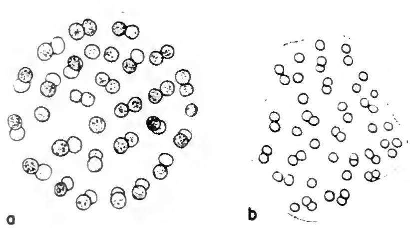

Figure 320

Fig. 320. a, *Aphanocapsa Grevillei* (Hass.) Rab.; b, *A. elachista* West & West.

Whereas *Microsystis* has cells compactly arranged, in this genus they are rather evenly spaced throughout the colonial mucilage. The cells are spherical and vary in size in different species, some being not much larger than bacteria and can be mistaken for them. Cells often appear in pairs. There are several species reported from the United States.

440a (437) Cells crowded, usually with refractive false vacuoles. See Fig. 318 ....*MICROCYSTIS*

440b Cells evenly spaced within the mucilage; false vacuoles lacking. See Fig. 320..*APHANOCAPSA*

441a (427) Cells quadrangular, arranged in flat plates. Fig. 321.... ....***TETRAPEDIA***

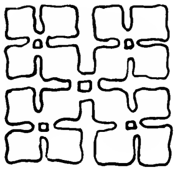

Figure 321

Fig. 321. *Tetrapedia* sp., diagram showing arrangement of rectangular cells.

Tetrapedia Reinschiana Arch. is a rare plant that has quadrangular cells arranged in multiples of 4 to form a flat rectangular plate. One other species has been reported from the United States, occurring in the plankton.

441b Cells some other shape....................................442

442a Cells solitary or in colonies of few cells, up to 32...........443

442b Cells numerous within a globular or amorphous gelatinous matrix. **448**

443a Without a gelatinous sheath. Fig. 322.......*SYNECHOCOCCUS*

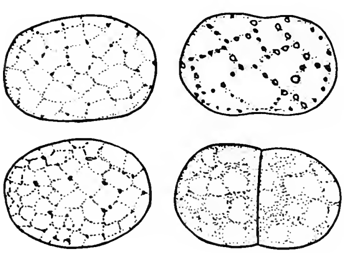

Figure 322

Fig. 322. *Synechococcus aeruginosus* Naeg.

This is a solitary unicell which does not possess a gelatinous sheath. Cells may be in pairs as a result of recent fission. They are relatively large for Cyanophyta (may be up to 35 microns in length) and are often conspicuous in the microscope mount because of their bright blue color.

443b With a gelatinous sheath (sometimes discerned with difficulty), or inclosed by a gelatinous matrix........................444

444a Cells elongate; pointed at the ends. Fig. 323 .... *DACTYLOCOCCOPSIS*

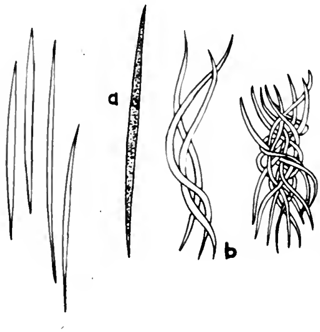

Figure 323

Fig. 323. a, *Dactylococcopsis acicularis* Lemm.; b, *D. fascicularis* Lemm.

These are fusiform shaped cells arranged with their long axes mostly parallel with that of the fusiform-shaped colonial envelope. Two species are known from this country, occurring in the plankton.

444b Cells not pointed at the ends 445

445a Cells heart-shaped, at the ends of radiating strands of mucilage; colonies globular. See Fig. 314 .... *GOMPHOSPHAERIA*

445b Cells not at the ends of radiating strands 446

446a Cells radiately disposed. Fig. 324 .... *MARSSONIELLA*

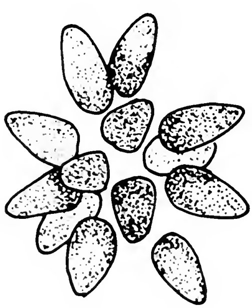

Figure 324

Fig. 324. *Marssoniella elegans* Lemm.

This species (the only one reported) has pear-shaped cells more or less definitely arranged about a common center with scarcely any evidence of a colonial mucilage. It is to be looked for in the plankton of open water.

446b Cells not radiately arranged 447

447a Individual cell sheath distinct. Fig. 325..........*GLOEOTHECE*

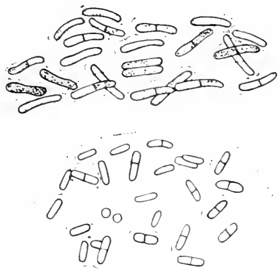

Figure 325

Fig. 325. *Gloeothece linearis* Naeg.

In this genus the cells are elongate cylinders or bacilliform in shape and are inclosed by individual sheaths all within a common mucilage. There are several species differentiated mostly by cell shape and size. Species should be compared with *Aphanothece* (Fig. 327).

447b Individual cell sheath not apparent. Fig. 326...*RHABDODERMA*

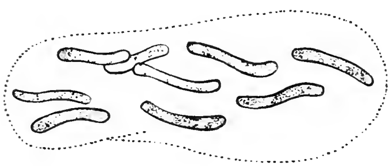

Figure 326

Fig. 326. *Rhabdoderma lineare* Schm. & Lauterb.

In this genus the cells are elongate and cylindrical, even vermiform and are much like *Gloeothece* except that there is no individual cell sheath. The plants occur in small colonies of 4, 8, or 16 in the plankton of lakes; is sometimes in the tychoplankton.

448a (442) Cells arranged at the periphery of a gelatinous matrix. See Fig. 319 ....*COELOSPHAERIUM*

448b Cells irregularly scattered throughout the colonial mucilage...449

449a Individual cell sheath not distinct. Fig. 327......*APHANOTHECE*

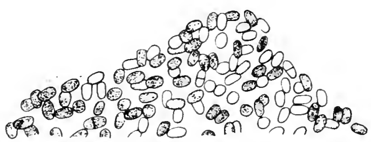

Figure 327

Fig. 327. *Aphanothece Castagnei* (Breb.) Rab.

Cells are elongate cylinders or bacilliform, occurring in large colonies up to 5 cm. in diameter and have no individual sheaths. The colonies develop on the bottom of lakes but become free-floating and are often washed into shallow water along shore where they may form a 'soupy' mass of brownish or olive-green (rarely bluish) bodies. Macroscopically they appear much like *Nostoc* colonies (Fig. 300) especially if the colonies are young and smooth in outline.

449b Individual cell sheath distinct. See Fig. 325......*GLOEOTHECE*

450a (345) Shells mostly circular or polygonal in outline (sometimes irregular), but with decorations (rows of dots, lines, etc.) which are concentrically arranged from a central point; raphe (distinct canal in wall in the median region) absent. Figs. 328 and 329. .... *CENTRALES**

Fig. 328. *Melosira granulata* (Ehr.) Ralfs.

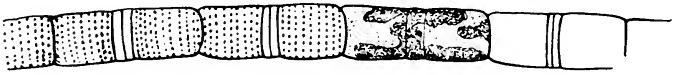

Figure 328

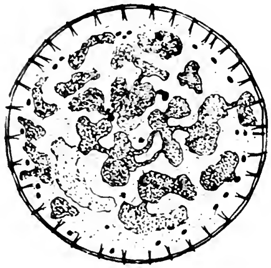

Figure 329

Fig. 329. *Stephanodiscus niagarae* Ehr.

450b Shells mostly elongate, cigar-shaped, boat-shaped, crescent-shaped, or rectangular, with decorations bilaterally arranged from longitudinal lines; raphe (distinct longitudinal canal in the wall in the median region) present or absent. Figs. 330 to 337.......... *PENNALES**

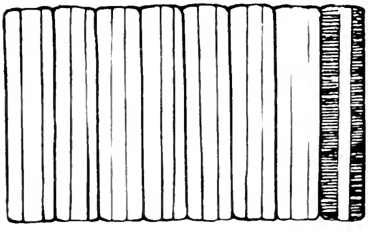

Figure 330

Fig. 330. *Fragilaria* sp.

*In order to identify diatoms satisfactorily special techniques are required for preparing them for microscopical study, and a descriptive key must of necessity employ highly specialized terminology. Space here does not permit the inclusion of all of the common diatom genera which occur in fresh water (which may number 50 or more). Hence a key which does not include all or most of them would be inadequate and actually misleading in many instances. A few of the more common genera, especially those found in the phytoplankton of lakes, are illustrated.

Diatoms occur in innumerable species both in the plankton, on the bottom, and on submerged aquatics, etc. The cells should be cleaned by boiling in acid so as to remove all organic content in order to make the wall characters visible. Identification of genera and species is based largely upon the shape of the cell and upon the manner of decoration, the presence of septae in the cells, and upon other details which cannot be seen unless the shells are clear and free from chromatophores and oil droplets. Some are so characteristically shaped that the genus can be determined without this treatment. The most common genera in the plankton are *Stephanodiscus, Melosira, Fragilaria, Asterionella, Navicula* and *Tabellaria*. *Stephenodiscus* is shaped like a drum; has a crown of short spines just within the margin. *Melosira* is capsule-shaped, with the cells arranged end to end in filaments. *Fragilaria* commonly has long, narrow rectangular cells placed side by side to form flat ribbons. *Tabellaria* forms zig-zag chains. *Navicula* is commonly 'boat-shaped' or cigar-shaped when the cell is seen in valve (top) view. *Asterionella* has cells radiating from a common center in one plane.

Fig. 331. *Tabellaria fenestrata* (Lyngb.) Kuetz.

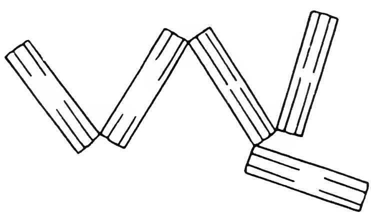

Figure 331

Fig. 332. *Meridion circulare* (Grev.) Ag.

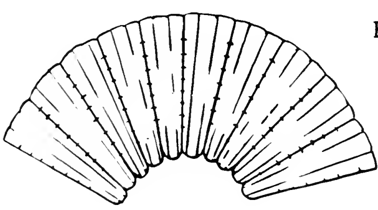

Figure 332

Fig. 333. *Asterionella formosa* Hass.

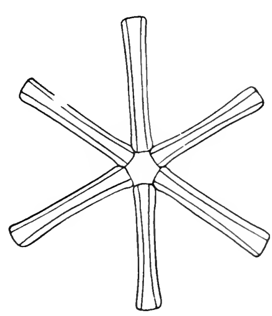

Figure 333

Fig. 334. *Navicula* sp.; a, top (valve) view; b, side (girdle) view.

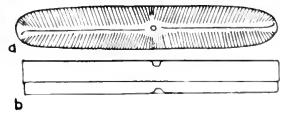

Figure 334

Fig. 335. *Gomphonema* sp.

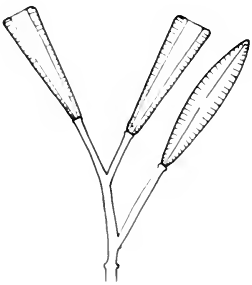

Figure 335

Fig. 336. *Surirella splendida* (Ehr.) Kuetz.

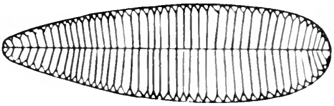

Figure 336

Fig. 337. *Cocconeis Pediculus* Ehr.

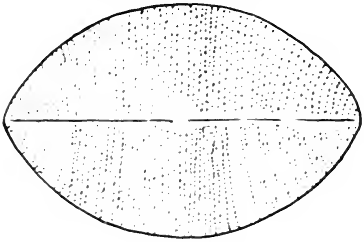

Figure 337

A CHECK LIST OF THE MORE COMMON GENERA OF FRESH-WATER ALGAE ACCORDING TO FAMILIES, ORDERS AND PHYLA

I. PHYLUM (DIVISION) CHLOROPHYTA

A. SUB-DIVISION CHLOROPHYCEAE

1. **Order Volvocales**

Family Polyblepharidaceae

Dunaliella
p. 36, fig. 32
Polyblepharides
p. 35, fig. 29
Pyramimonas
p. 35, fig. 30
Stephanoptera
p. 35, fig. 31

Family Chlamydomonadaceae

Carteria
p. 31, fig. 21
Chlamydomonas
p. 34, fig. 27
Chlorogonium
p. 33, fig. 25
Lobomonas
p. 33, fig. 26
Platymonas
p. 31, fig. 20
Sphaerellopsis
p. 34, fig. 28

Family Phacotaceae

Phacotus
p. 32, fig. 23
Pteromonas
p. 33, fig. 24
Scotiella
p. 84, fig. 127
Wislouchiella
p. 32, fig. 22

Family Volvocaceae

Eudorina
p. 29, fig. 17
Gonium
p. 26, fig. 10
Pandorina
p. 28, fig. 14
Platydorina
p. 26, fig. 9
Pleodorina
p. 30, fig. 18
Volvox
p. 28, fig. 15

Family Spondylomoraceae

Chlamydobotrys
p. 27, fig. 13
Pascheriella
p. 27, fig. 11
Spondylomorum
p. 27, fig. 12

Family Sphaerellaceae

Haematococcus
p. 30, fig. 19
Stephanosphaera
p. 29; fig. 16

2. **Order Tetrasporales**

Family Palmellaceae

Asterococcus
p. 46, fig. 51
Dispora
p. 49, fig. 58
Gloeocystis
p. 41, fig. 41
Hormotila
p. 99, fig. 154
Palmella
p. 38, fig. 36
Palmodictyon
p. 43, fig. 45
Sphaerocystis
p. 48, fig. 54

Trachelomonas
p. 24, fig. 5

Family Colaciaceae
Colacium
p. 52, fig. 64

III. PHYLUM (DIVISION) PYRRHOPHYTA

A. SUB-DIVISION CRYPTOPHYCEAE

Family Cryptochrysidaceae
Chroomonas
p. 150, fig. 254
Family Cryptomonadaceae
p. 150, fig. 255

B. SUB-DIVISION DINOPHYCEAE

Order 1. Dinokontae

Family Gymnodiniaceae
Gymnodinium
p. 151, fig. 257
Family Gonyaulacaceae
Gonyaulax
p. 152, fig. 259
Family Glenodiniaceae
Glenodinium
p. 153, fig. 261
Hemidinium
p. 153, fig. 260
Family Peridiniaceae
Peridinium
p. 152, fig. 258
Family Ceratiaceae
Ceratium
p. 151, fig. 256

Order 2. Dinococcales

Family Dinococcaceae
Cystodinium
p. 149, fig. 253
Raciborskia
p. 149, fig. 252
Tetradinium
p. 149, fig. 251

IV. PHYLUM (DIVISION) CHLOROMONADOPHYTA

Gonyostomum
p. 23, fig. 4

V. PHYLUM (DIVISION) CHRYSOPHYTA

A. SUB-DIVISION XANTHOPHYCEAE (HETEROKONTAE)

1. **Order Heterocapsales**
Family Heterocapsaceae
Chlorosaccus
p. 142, fig. 238
2. **Order Heterococcales**
Family Pleurochloridaceae
Arachnochloris
p. 140, fig. 232
Botrydiopsis
p. 137, fig. 224
Chlorallantus
p. 141, fig. 234
Chlorocloster
p. 139, fig. 230
Diachros
p. 136, fig. 223
Goniochloris
p. 142, fig. 237
Monallantus
p. 138, fig. 227
Perone
p. 133, fig. 216
Pleurogaster
p. 139, fig. 229
Tetragoniella
p. 141, fig. 236

VI. PHYLUM (DIVISION) CYANOPHYTA

VII. PHYLUM RHODOPHYTA

INDEX AND PICTURED-GLOSSARY

A

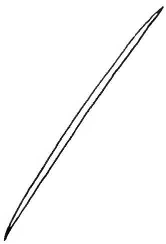

Figure 338

Figure 339

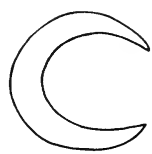

Figure 340

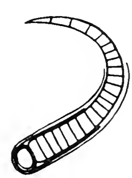

Figure 341

nally (especially the latter. e.g., an axial chloroplast). Fig. 342

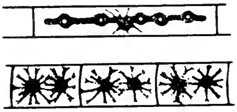

Figure 342

B

BACILLIFORM: rod-shaped.
Bangia 127
fuscopurpurea 127
Basicladia 119
Chelonum 119
BASIC WATER: hard water containing an abundance of dissolved minerals or chemical elements.
Batrachospermum 110, 125; also 22, 127
Boryanum 110
moniliforme 110
vagum 110
BILOBED: with two lobes or extensions.
Binuclearia 105
tatrana 105
BIPAPILLATE: with two small protrusions; nipples.
BISCUIT-SHAPED: a thickened pad; pillow-shaped
BIVALVE (wall): wall of a cell which is in two sections, one usually slightly larger than the other. (See *Melosira*, Fig. 328)
Bladderwort: see *Utricularia*.
BLEPHAROPLAST: a granular body in a swimming organism from which a flagellum (organ of locomotion) arises.
BLOOM: see Water Bloom.
Blue-green Algae 6
Bohlinia 80, 84
echidna 80
Botrydiopsis 137, 143
arhiza 137
eriensis 137
Botrydium 132; also 22
granulatum 132
Wallrothii 132
Botryococcus 45, 129; also 22
Braunii 45
BRISTLE: a stiff hair; a needle-like spine.
Brown Algae, see Phaeophyta
Bulbochaete 122; also 102
congener 122
insignis 122
Bumilleria 132
exilis 132
sicula 132
Bumilleriopsis 138
brevis 138

C

Calothrix 160, 167
atricha 160
Braunii 160
epiphytica 160
CAPITATE: with an enlargement or a head at one end. Fig. 343

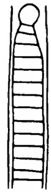

Figure 343

Capsosira 168
Brebissonii 168
CAROTENE: orange - yellow plant pigment of which there are four kinds in algae; a hydrocarbon, $C_{40}H_{56}$.
CARPOGONIUM: female sex organ in the red algae; a flask-shaped cell with a long, hair-like extension, the trichogyne.
Carteria 31
cordiformis 31
Klebsii 31
CARTILAGINOUS: tough but pliable; resilient.
CELLULOSE: an insoluble carbohydrate, $C_6H_{10}O_5$, of which most plant cells are composed.
CENTRAL BODY: the central region of a blue-green algal cell, relatively unpigmented and containing nuclear granules.
CENTRALES: a subclass of the Diatomaceae which includes cells with radial symmetry and radiately disposed wall markings; cells round in end view, 186.
Centritractus 139
belanophorus 139
Cephaleuros 115; also 13, 22
virescens 115
Cerasterias 86
irregulare 86
Ceratium 151
hirundinella 151
Ceratophyllum 166
Chaetonema 113
irregulare 113
Chaetopeltis 114
orbicularis 114
Chaetophora 122; also 113, 123
elegans 122
incrassata 122
Chaetosphaeridium 51, 67, 99
globosum 51
Chamaesiphon 176
incrustans 176
Chamaesiphonaceae 177
Chantransia 127
Chara 21; also 20
canescens 21
coronata 21
excelsa 21
Characeae 1, 6, 20
Characiopsis 133, 135; also 63, 68, 134
acuta 133
cylindrica 133
spinifer 133
Characium 63, 68; also 133, 134
Debaryanum 63
ornithocephalum 63
rostratum 63
Charophyceae, 4
Chlamydobotrys 27
gracilis 27
Chlamydomonas 34, 129; also 82
nivalis 34; also 13
Palmella-stage 40
polypyrenoideum 34
sphagnicola 34
Chlorallantus 141
oblongus 141
Chlorangium 52
stentorinum 52
Chlorella 65, 83
conductrix 65
ellipsoidea 65
parasitica 65
Chlorellidiopsis 143
separalibis 143
Chlorobotrys 136, 143
regularis 136
Chlorochromonas 135
minuta 135
Chlorochytrium 66; also 37, 84
Lemnae 66; also 37
Chlorocloster 139
pyreniger 139
Chlorococcales 6, 64, 65, 80, 82, 84
Chlorococcum 42, 62, 83
humicola 42
infusionum 42
Chlorogonium 33
Chloromonadophyta 8, 10, 23
Chloromonads 8
Chlorophyceae 4
CHLOROPHYLL: a green pigment of which there are five kinds in the algae, Chlorophyll-a occuring in all of the algal Divisions.
Chlorophyta 4, 6, 7, 22, 25, 124, 128, 131, 136, 139
CHLOROPLAST: a body of various shapes within the cell containing the pigments of which chlorophyll is the dominant one.
Chlorosaccus 142
fluidus 142
Chlorosarcina 37
consociata 37
Chlorothecium 133, 135
Pirottae 133
Chlorotylium 117
cataractum 117
Chodatella 79, 84

CHROMATOPHORE: body within a cell containing the pigments of which some one other than chlorophyll (green) is predominant; may be red, yellow, yellow-green or brown.

CILIA: fine, hair-like extensions of a cell membrane used as organs of locomotion or for feeding in the Protozoan Class, Ciliata.

CILIATA: a Class of the Protozoa, swimming by means of numerous, fine, hair-like extensions of the cell membrane.

COENOCYTIC: a plant with multinucleate cells or cell-like units; a multinucleate non-cellular plant, e. g. *Vaucheria* (See Fig. 199).

COLLAR: a thickened ring or neck surrounding the opening into a shell through which a flagellum projects from the inclosed organism.

COLONIAL MUCILAGE: a gelatinous investment or sheath which incloses several to many cells.

COLONY: a group or closely associated cluster of cells, adjoined together or merely inclosed by a common investing mucilage or sheath; cells not arranged in a linear series to form a filament.

COLUMNAR CELLS: See corticating cells.

CONCENTRIC: arranged about a common center.

CONE-SHAPED; CONICAL: a figure circular in cross section, broad at the base and tapering symmetrically from base to apex.

CONFLUENT: running together or intermingling, as mucilaginous sheaths of plants becoming intermingled. Fig. 344

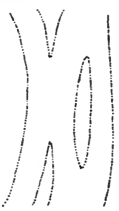

Figure 344

CONJUGATION: sexual reproduction between cells which become joined or "yoked" together, the gametes (sex cells) moving in an amoeboid fashion. Fig. 345

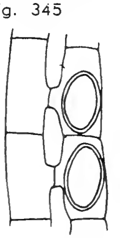

Figure 345

CONJUGATION TUBES: tubes which are put out by one or both cells in sexual reproduction providing for the uniting of gametes; see Conjugation.

CONSTRICTED: cut in or incised, usually from two opposite points on a cell so that an isthmus is formed between two parts; indented, as are the lateral walls of cells of a filament at the cross walls. Fig. 346

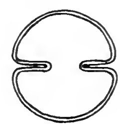

Figure 346

CONTRACTILE VACUOLE: a small vacuole (cavity) which is bounded by a membrane that pulsates, expanding and contracting.

CORTEX; CORTICATING CELLS: cells superimposed on the main filament or axial part of a plant body; investing cells, e. g., *Chara*, *Batrachospermum*. (See Fig. 2)

CRENULATE: wavy with small scallops; with small crenations.

CRESCENT: an arc of a circle; a curved figure tapering to horn-like points from a wider, cylindrical midregion. See lunate.

CROWN CELLS: the cells formed at the tips of the investing elements that are spirally twisted about the egg in the Characeae.

CUP-SHAPED: a more or less complete plate (as a chloroplast) which lies just

within the cell wall, open at one side to form a cup. Fig. 347

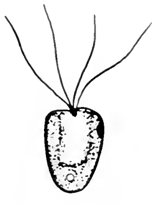

Figure 347

D

E

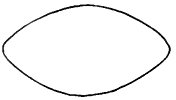

Figure 348

F

FAA (Preservative) 16
FALSE BRANCH: a branch formed by lateral growth of one or both ends of a broken filament; a branch not formed by lateral division of cells in an unbroken filament.
FALSE FILAMENT: an arrangement of cells to form a short or loose thread; not forming a definite linear series of cells.
Family (defined), 3
FIBRIL: a fine thread.
FILAMENT: a thread of cells; one or more rows of cells; in the blue-green algae the thread of cells together with a sheath that may or may not be present, the thread of cells referred to as a trichome, which see.
FISSION: cell division by constriction not involving nuclear division (mitosis).
FLAGELLAR VACUOLES: cavities in the cytoplasm at the anterior end of a motile cell, at the base of the flagella, which see.
FLAGELLUM: a relatively coarse, whip-like organ of locomotion, arising from a special granule, the blepharoplast, within a cell.
FLANGE: a longitudinal bulge or wing-like vertical extension from the surface of an organism or cell.
FLASK-LIKE: broad at the base and abruptly narrowed to a neck-like extension.
FLORIDEAN STARCH: a food reserve produced within the red algae (Rhodophyta) different from the starches formed by other plants.
FOLIOSE: leaf-like; a flat or curled, expanded thallus.
Formalin (preservative), 16
Fragilaria 187; also 186
Franceia 56, 79, 84
Droescheri 56
Fridaea 121
torrenticola 121
FUCOXANTHIN: a brown pigment predominant in the Phaeophyta.
FUSIFORM: a figure broadest in the midregion and gradually tapering to both poles which may be acute or bluntly rounded; shaped like a spindle. Fig. 349

Figure 349

G

GAMETANGIUM: any cell, specialized or unspecialized, which produces gametes (male or female sex cells).
GAMETE: a sex cell; cells which unite to produce a fertilized egg or zygospore, which see.
Geminella 106, 107
interrupta 106
mutabilis 106
Genicularia 72, 94; also 73
elegans 72
GENICULATE; GENICULATION: bent, as a knee-joint; bending or abruptly curved.
Genus, defined, 3
GIRDLE VIEW: see Valve.
Glaucocystis 129, 178
duplex 129
Nostochinearum 129
Glenodinium 153
Kulczynski 153
Gloeobotrys 143
limneticus 143
Gloeocapsa 180
punctata 180
Gloeochaete 128, 178; also 129
Wittrockiana 128
Gloeochloris 142
Smithiana, synonym of *Chlorosaccus fluidus*, 142
Gloeocystis 41, 46, 48, 82, 129; also 40, 99
ampla 41
gigas 41
major 41
Gloeotaenium 61, 85
Loitelsbergerianum 61
Gloeothece 185
linearis 185
Gloeotrichia 166; also 167
echinulata 166
natans 166
Pisum 166
Glycerin, in preservative, 16, 17; in mounts, 22, 150
Glycerin Jelly, for mounts, 16, 17
GLYCOGEN: a starch-like storage product questionably identified in food granules of the Cyanophyta.
Golenkinia 61, 79
paucispina 61
radiata 61
Gomontia 116; also 117
Holdenii 116
Gomphonema 188
Gomphosphaeria 179, 184
aponina 179
lacustris 179
Gonatozygon 73
aculeatum 73
Gonatozygonaceae 72, 73
Gongrosira 117, 119; also 118
Debaryana 117
Goniochloris 142
sculpta 142
Gonium 26
pectorale 26
Gonyaulax 152
palustre 152
Gonyostomum 23; also 8
semen 23
GREGARIOUS: an association; groupings of individuals not necessarily joined together but closely assembled.
GULLET: a canal leading from the opening of flagellated cells into the reservoir in the anterior end. (See *Euglena*, Fig 8.)
Gymnodinium 151
fuscum 151
palustre 151
Gymnozyga 90; also 88
moniliformis 90
GYPSUM: granules of calcium sulphate which occur in the vacuoles of some desmids. (See *Closterium*, Fig. 86.)

H

HAEMATOCHROME: a red or orange pigment, especially in some Chlorophyta and Euglenophyta, which masks the green chlorophyll.
Haematococcus 30, 130; also 22, 33
lacustris 30
Hapalosiphon 169
hibernicus 169
HARD WATER: abundantly supplied with dissolved minerals; with a pH above neutral (7.0).
Hemidinium 153
nasutum 153
Herbarium Specimens 16
HETEROCYST: an enlarged cell in some of the filamentous blue-green algae, usually empty and different iln shape from the vegetative cells. Fig. 350

Figure 350

HETEROGAMETE: a gamete (sex cell) clearly differentiated in respect to maleness or femaleness (antherozoid and egg).
Heterokontae 126
HOLD-FAST CELL: a basal cell of a filament or thallus differentiated to form an attaching organ.
Holopedium 181
irregulare 181
HORIZONTAL GROWTH: growth more or less at right angles to outwardly or upwardly projecting filaments or parts; usually growth parallel with a substrate to which a plant is attached.

Hormidiopsis 105
ellipsoideum 105
Hormidium 107; also 104-106
Klebsii 107
Hormotila 99
mucigena 99
Hot Springs 13
H-SHAPED SECTIONS: segments of filaments or terminal cells of filaments which result from separation of cells, one from the other, at the midregion rather than at the cross walls, the cell wall being composed of two sections which adjoin and overlap midway between the end walls. (See Figs. 172, 212); also in a chloroplast shape where there are 2 broad sections lying along the side walls and connected by a narrow cross band. Fig. 351

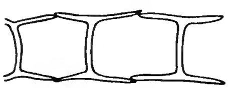

Figure 351

Hyalobryon 146
mucicola 146
Hyalotheca 90; also 88, 135
dissiliens 90
mucosa 90
Hydra 65
Hydrocoleum 164
homeotrichum 164
oligotrichum 164
Hydrodictyon 54
reticulatum 54
Hydrurus 144
foetidus 144
Hyella 176
fontana 176

I

INCISED; MEDIAN INCISION: cut in; with a narrow cut from the margin. Fig. 352

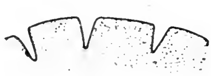

Figure 352

Indian Turnip 66
INFOLDED: as in cross walls of a filamentous alga which are not smooth, even membranes but have folds extending back into the cavity of the cell. *Desmidium* and certain species of *Spirogyra* have this type of wall; replicate.
INTERCALARY: arranged in the same series, as spores or heterocysts which occur in series with vegetative cells rather than being terminal or lateral.
INTERNODE: the space or section of a filament or thallus extending between branch - bearing or enlarged portions (nodes).
INTERSTICES: openings or spaces between adjoined cells; openings in the mucilage which incloses colonial algae.
INTESTINIFORM: a thallus in the form of a tube, often crinkled, sometimes branched.
INVAGINATION: concavity; a depression from an otherwise smooth or plane surface.
IODINE TEST: application of a weak solution of iodine (Lugol's) to determine presence of starch; starch-iodide, which is formed when iodine is applied to cells of the Chlorophyta, appears as a blue-black substance.
ISODIAMETRICAL: a figure with all planes having an equal diameter or nearly so.
ISOGAMETE: a sex cell which shows no detectable differentiation in respect to maleness or femaleness.

J

JOINT: point or plane where two cells or elements adjoin.
Jack-in-the-pulpit, see *Arisaema*

K

KELP: common name for the larger brown sea weeds.
Kentrosphaera 84
Bristolae 84
Kirchneriella 49, 65; also 53
lunaris 49
obesa var. *major* 49

L

Lagerheimia 79, 84; also 56
longiseta 79
quadriseta 79
Lagynion 147
reductum 147
triangularis var. *pyramidatum* 147
L A M E L L A; LAMELLATE: with layers; with plates lying against one another.
LAMINARIN: a polysaccharide carbohydrate used as food storage in Phaeophyta.
LAMINATE: plate-like; layered.
LATERAL CONJUGATION: reproduction involving the formation of a connecting tube around the end wall of two adjacent cells in the same filament so that contents of the cell may fuse to form a zygospore.
Lemanea 124
annulata 124
Lemna 12, 37, 66
trisulca 12, 66
Lepocinclis 25
acuta 25
glabra fa. *minor* 25
Leptosira 117; also 22
Mediciana 117
LEUCOSIN: a whitish food reserve characteristic of many of the Chrysophyta, especially the Heterokontae; gives a metallic lustre to cell contents.
Leuvenia 137
natans 137
LICHEN: a duplex plant thallus formed by a fungus and an alga living in close association, 80, 109.
Lime (Marl Deposits) 21
LINEAR SERIES: cells or units arranged in a single row.
Lobomonas 33
rostrata 33
LOBULE: a small lobe; a secondary division of a lobe.
LONGITUDINAL FURROW: a groove in the dinoflagellate cell which extends parallel with the long axis.
LORICA: a shell-like structure of varying shapes which houses an organism, has an opening through which organs of locomotion are extended. (See *Trachelomonas*, Fig. 5.) Fig. 353

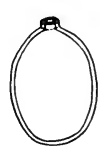

Figure 353

LUNATE: crescent - shaped, as of the new moon.
Lyngbya 159, 162
Birgei 159
contorta 159

M

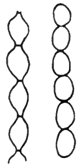

Figure 354

N

O

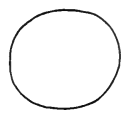

Figure 355

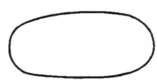

Figure 356

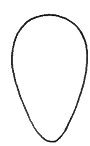

Figure 357

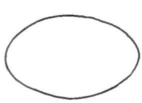

Figure 358

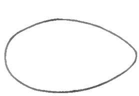

Figure 359

P

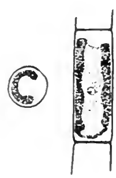

Figure 360

PLANE (END WALLS), smooth, not folded walls; opposite of replicate. Fig. 361

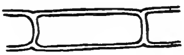

Figure 361

PLANKTON: organisms drifting in the water, or if swimming, not able to move against currents.
Plankton Net 14
Planktosphaeria 48, 62
gelatinosa 48
PLASTID, a body or organelle of the celle, either containing pigments or in some cases colorless.
PLATE, sections, polygonal in shape, composing the cell wall of some Dinoflagellate (the thecate or armored dinoflagellates). Fig. 362

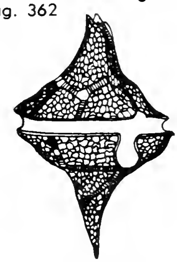

Figure 362

Platydorina 26
caudatum 26
Platymonas 31
elliptica 31
Plectonema 161
Wollei 161
Pleodorina 30, also 29
californica 30
illinoisensis 30
Pleurocapsa 177
minor 177
Pleurococcus 53, 62, 83
vulgaris 53
Pleurodiscus 94
purpureus 94
Pleurogaster 139, 140
lunaris 139
Pleurotaenium 71; also 72
nodosum 71
trabecula 71
POLAR; POLE, referring to the two opposite ends of a cell or an organism, or to differentiate points in a circular cell; the ends of an axis.
Polyblepharides 35
fragariiformis 35
Polyedriopsis 86, 87
quadrispina 86
spinulosa 86
POLYGONAL, many sided.
POLYHEDRAL, a figure with more than four sides.
Porphyridium 130
cruentum 130
Porphyrosiphon 162
Notarisii 162
POSTERIOR, toward the rear; the end opposite the forward or anterior end of a cell or of an organism.
Prasinocladus 100
lubricus 100
Prasiola, 98; also 92
crispa 98
Preserving; Preserving Fluids 16, 17
PROCESS, an extension of a cell, or of a cell wall, or of a thallus; a horn, arm, or abrupt protrusion from a plane surface. Fig. 363

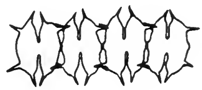

Figure 363

Protococcus 53, 62, 83; also 104
viridis 53
Protoderma 114
viride 114
PROTONEMA, the filamentous stage in the development of moss plants.
PROTOPLAST, the living part of a cell; the cell membrane and its contents, usually inclosed by a cell wall of dead material.
Protozoa 2, 12, 23
PSAMMON, the organisms inhabiting the soil (especially sand) above the high water level of lake or river beaches.
Pseudochaete 112
gracilis 112
PSEUDOCILIA, meaning false cilia; flagella-like structures not used for locomotion.
PSEUDOPARENCHYMATOUS, a false cushion; a pillow-like mound of cells (usually attached) which actually is a compact of short, often branched filaments. Fig. 364

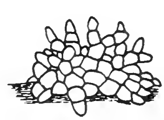

Figure 364

PSEUDOPODIUM, meaning a false foot; locomotory organ formed by lobe-like extension of the protoplasm, found in some Chrysophyta and in the Sarcodina Protozoa.
Pseudotetraedron 137
neglectum 137
Pseudoulvella 115
americana 115
PSEUDOVACUOLE, meaning a false vacuole; a pocket in the cytoplasm of many blue-green algae which contains gas or mucilage, is light-refractive. (See *Microcystis*, Fig. 318.)
Pteromonas 33
aculeata 33
PUNCTAE, minute, pin-point pores within the cell wall; minute pits either extending completely through the wall or not. Fig. 365

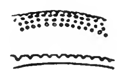

Figure 365

PYRAMIDAL; PYRAMIDATE, in the shape of a pyramid; a pointed, 3-sided figure with a broad base. Fig. 366

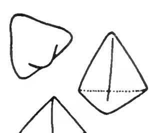

Figure 366

Pyramimonas 35; also 10
tetrarhynchus 35
PYRENOID, a protein body around which starch or paramylum collects in a cell, usually buried in a chloroplast but sometimes free within the cytoplasm.
PYRIFORM, see Pear-shaped Fig. 367

Figure 367

Pyrrhophyta 8, 11, 82

Q

QUADRATE, four-sided; with a general outline showing four sides.
Quadrigula 50
Chodatii 50

R

Raciborskia 149
bicornis 149
RADIATE, extending outward in several planes from a common center; extending in one plane in several directions from a common point.
Radiofilum 106
conjunctivum 106
flavescens 106
Ragweed 66
RAPHE, a longitudinal canal within the wall of diatoms belonging to the Pennales, forming a median line on one or both sides of the diatom shell.
RECTANGULAR, a figure with four right angles.
RECTILINEAR, arranged in straight rows in two directions.
Red Algae, see Rhodophyta
Red Snow, see Snow
RENIFORM, kidney-shaped; bean-shaped. Fig. 368

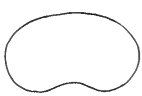

Figure 368

REPLICATE, infolded; folded back as in the cross walls of some *Spirogyra;* not a straight or plane cross wall. Fig 369

Figure 369

RESERVOIR, cavity in the anterior end of flagellated cells from which the organs of locomotion arise.
RETICULATE, netted; arranged to form a network; with openings. Fig. 370

Figure 370

Rhabdoderma 185
lineare 185
Rhizochrysis 148, 156
limnetica 148
Rhizoclonium 102, 116, 121; also 103
hieroglyphicum 102
Hookeri 102
RHIZOID; RHIZOIDAL, root-like; a downward projecting root-like branch or cell, usually without regularity.
RHIZOPODIAL, irregularly branched, root-like extensions of protoplasm used for locomotion.
Rhodochytrium 66; also 22
spilanthidis 66
Rhododendron 115
Rhodophyta 8, 11, 22, 110, 124, 126, 127, 129.
Ricciocarpus 12
natans 12
Rivularia 167; also 166
Rivulariaceae 160
Rotifer 12
Roya 73
obtusa 73

S

SACCATE, like a sac; balloon-like cell or colony of cells, or plant body. Fig. 371

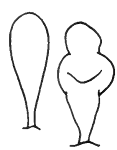

Figure 371

SACCODERM DESMID, false desmids; cells which have plane, unpitted walls all in one piece. See Placoderm Desmid.
Sacconema 166
rupestre 166
SARCINA ARRANGEMENT, cells arranged in the form of a cube.
SCALARIFORM, ladder-like; sexual reproduction by conjugations tubes formed between cells of two filaments forming a ladder-like figure.
Scenedesmus 57, 58; also 6, 36
bijuga var. *alternans* 57
incrassatulus var. *mononae* 57
opoliensis 57
quadricauda 57
Schizochlamys 45; also 136
gelatinosa 45
Schizogoniaceae; Schizogoniales, 92, 98
Schizogonium 92; also 98
crenulatum 92
murale 92
Schizomeris 101, 110
Leibleinii 101
Schizothrix 165
tinctoria 165
Schroederia 64, 69
ancora 64
Judayi 64
setigera 64
Scotiella 84; also 14, 33
nivalis 84
SCROBICULATE; SCROBICULATION, with saucer-like depressions in a plane surface (cell wall), sometimes deep. Fig. 372

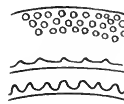

Figure 372

Scytonema 174
Archangelii 174
Scytonemataceae 161, 175
Sea Weed 11
Sea Wrack 2
Selenastrum 53, 65
gracile 53
SEMICELL, a cell-half, as in the Placoderm desmids in which the cell has two parts that are miror images of one another, the two parts often connected by a narrow isthmus.
SEPTUM, a cross-partition, cross wall or a membrane complete or incomplete through the short diameter of a cell, sometimes parallel with the long axis.
SERRATE, toothed; jagged.
SETA, a hair, usually arising from within a cell wall; or a hair-like extension formed by tapering of a filament of cells to a fine point. Fig. 373

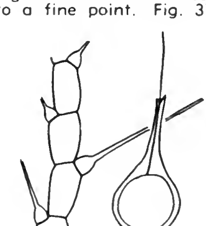

Figure 373

SHEATH, a covering, usually of mucilage, soft or firm; the covering of a colony of cells or an envelope about one or more filaments of cells.

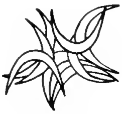

Figure 374

T

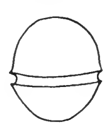

Figure 375

TRAPEZIFORM; TRAPEZOID, a figure which has two parallel sides; shaped somewhat like a trapezoid. Fig. 376

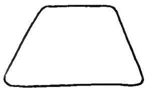

Figure 376

Trebouxia 80
Cladoniae 80
Trentepohlia 109, 116, 119; also 10, 13
aurea 109
Iolithus 109
Treubaria 87
crassispina 87
Tribonema 131; also 132
bombycinum 131
bombicinum var. *tenue* 131
utriculosum 131
TRICHOCYST, organelle which is capable of throwing out stinging fibrils of mucilage. (See *Gonyostomum*, Fig. 4.)
Trichodesmium 162, 163
erythraceum 162
lacustris 162
TRICHOGYNE, a slender extended neck on the female sex organ (carpogonium) of the Rhodophyta.
TRICHOME, a thread; the series of cells in the Cyanophyta exclusive of a sheath which may be present; a fine hair-like extension.
Triploceras 70
gracile 70
Trochiscia 80
granulata 80
obtusa 80
reticularis 80
TRUE BRANCH, a branch formed by means of lateral division of cells in the main filament of a plant.
TRUNCATE, cut off abruptly at the tip; flat at the end as opposed to being rounded or pointed. Fig. 377

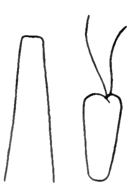

Figure 377

TUBERCLE, a button-like knob or protuberance.
TUBULAR; TUBULAR THALLUS, a thread-like growth without cross walls; a plant body in the form of a tube.
TUMID, swollen or convex on the sides. Fig. 378

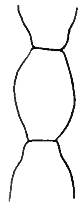

Figure 378

Tuomeya 126
fluviatilis 126
Turtle 13, 19
TYCHOPLANKTON, the plankton of waters near shore; organisms floating and entangled among weeds and in algal mats, not in the open water of a lake or stream

U

Ulothrix 107, 108; also 101
aequalis 107
cylindricum 107
zonata 107
Ulotrichales 53
Ulvella 115
involens 115
UNDULATE, regularly wavy.
UNILATERAL, on one side.
UNISERIATE, cells arranged in a single row. See Multiseriate.
Urococcus 82
insignis 82
Uroglenopsis 155
americana 155
Uronema 108
elongatum 108
UTRICLE, a sac-like or tubular sheath, usually a firm mucilaginous covering. Fig. 379

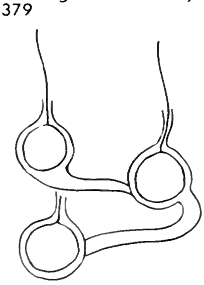

Figure 379

Utricularia 15, 51

V

VALVE, one of two parts of a diatom cell wall; valve view, when the cell is seen from the top or bottom; girdle view, when the cell is seen from the side which thus shows the overlapping of the two valves.
Vaucheria 124
geminata 124
sessilis 124
VEGETATIVE, referring to a non-reproductive stage, activity, or cell, as opposed to activities and stages involved in reproduction, especially sexual reproduction.
VENTRAL, the under or lower side or surface of an organism or cell.
VERMIFORM, long, narrow and crooked in shape; worm-shaped.
VERRUCA, a warty projection; a protrusion which bears knobs or spines. Fig. 380.

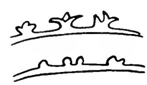

Figure 380

VERRUCOSE, roughened; with irregular thickenings on the surface. Fig. 381

Figure 381

VESICLE, a sac or balloon-like cell or thallus.
Volvocaceae 26
Volvocales 27, 36, 84
Volvox 28; also 29, 30 155
tertius 28

W

WATER BLOOM, a profuse growth of planktonic algae which cloud or color the water, often forming floating scums.
Water Net (*Hydrodictyon*) 54
Westella 60
botryoides 60
WHORL, several parts, branches or leaves arising at one level from around an axis.
Wislouchiella 32
planctonica 32
Wollea 171
saccata 171

X

Y

Z

THE FRESH-WATER ALGAE